

LITHOSTAR Multiline

SP

Replacements of Parts

System

Unit not including shock wave system

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Document revision level

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- Observe the EMC measures for systems with serial number starting with 06022 (EMC = electromagnetic compatibility).
- Observe ESD protective measures (ESD = electrostatically sensitive device).
- Ensure that the EMC shielding is reinstalled correctly after removing it to replace or check boards.
- Check the connection pins when inserting boards and connectors.
- Remove the system covers for the area of the system being serviced and reinstall them after the service work is completed.

NOTICE

Protective conductor test and backup:

⇒ **When service work is completed, perform a protective conductor test and a backup of the new parameters.**

Documents required

- | | |
|---|--------------------|
| • SAFETY NOTES | RA0-000.012.29... |
| • LITHOSTAR Multiline Startup Instructions | RXL2-120.034.01... |
| • LITHOSTAR Multiline wiring diagram set | J1042 |
| • Operation of the service software | RXL2-120.113.01... |
| • Setting the software parameters | RXL2-120.032.01... |
| • Jumper log | 31 27 011 EBP 01S |
| • Start-up Instructions | RXL2-120.034.01... |
| • MEMOSKOP Service Instructions | RX57-029.061.01... |
| • VIDEOMED DI/DI-M Service Instructions | RX52-022.061.01... |
| • MULTISPOT 2000 Setting Instructions | RX57-091.032.01... |
| • POLYDOROS LX 30/50 Troubleshooting Instructions | RX63-020.072.01... |

Required measurement and adjusting devices

- Special tool, PLCC extractor 99 00 549 LE999
- 96-pin extension board, short 85 73 628 G5206
- 2x96-pin extension board 73 94 943 EE999
- 1x64-pin extension board 21 67 179 N2030
(This board can also be used on the 48-pin connectors)
- Service PC (for details see Intranet service laptop for CSEs)
- Serial PC connection cable, 5m 99 00 440 RE999
- Multimeter (Class 0.1%; $R_i > 10\text{ M}$), e. g., Fluke 8060 A 97 02 101 Y4290
- Oscilloscope, e.g., Fluke Scope Meter 73 92 074
- ESD tools according to ARTD, Part 3
- Standard service equipment kit
- A stretching belt or similar device (approximately 4.5 m long and 25 mm wide), must be purchased locally.
- 5 mm Allen wrench with guide pin

Disposal information

When disposing of boards and components no longer required, adhere to the Disposal Instructions RXL2-120.163.01... .

Service information on the Intranet

The most recent information is available on the Intranet.

Component N11 (in control cabinet A12)

Boa rd	Part no.	Name	Remarks regarding replacement - Tool tip		Detail info
		Fuses	Replace according to wiring diagram J1042-3A		n.a.
D1	71 28 841 J1042	Host com- puter	Check switches according to wiring diagram excerpt in Appendix. (Appendix / p. 70) Wiring diagram 1042-21-4 Set time, restore the parameters, download software		(Board D1, (new type) host com- puter or when replac- ing the battery / p. 2 1).
	30 82 138	Battery	Set time, restore parameters		
D1	31 25 825 J1042	Host com- puter	Activate battery: Solder in jumper X26-X27; check jumpers/switches; jumper log Wiring diagram J1042-21 Replace Proms, set time, restore the parameters, download software		(Board D1, (old type) host com- puter or when replac- ing the battery / p. 2 2)
	31 46 073 B2905	Battery	Set time, restore parameters		
D2	31 25 643 J1042	XCS controller	Check jumpers/switches; replace Proms; jumper log, wiring diagram J1042-22 Change EMC shielding plate, if present, from old to new board		n.a.
D4	89 49 588 G5334	Motor controller	Check jumpers/switches; replace Proms		(Board D4xx, Motor controller / p. 24)
D5	31 25 528 J1042	A/D con- verter	Check jumpers; replace Proms Check U _{ref} , setting on D8 with R220		(Board D 5, A/D converter / p. 24)
D5	37 82 714 J1042	A/D converter	- Board backward-compatible (starting with HOST Software VA00D)		
			- May only be oper- ated with Prom:	- J1 Part no. 47 81 857 J1042 - J2 Part no. 47 81 865 J1042	
			Check jumpers; replace Prom; check U _{ref} setting on D8 with R220		

Board	Part no.	Name	Remarks regarding replacement - Tool tip	Detail info
D6	31 25 569 J1042	COM controller	Check jumpers/switches; replace Proms; jumper log, wiring diagram J1042-26 Change EMC shielding plate, if present, from old to new board	n.a.
D7	89 49 505 G5334	Motor output stages	No special attention necessary	n.a.
D8	31 73 911 B3305	+5V power supply	Set the reference voltage $U_{ref} = 5.120V \pm 5 \text{ mV}$ with R220; test point U_{ref} : D5.X31 (0V; X30) Prior to installing the board, set potentiometer R220 to the lowest value	n.a.
D10	11 14 839 G5347	Bus board	starting with serial no. 7000: Transfer the jumper from the old board to the new board. Jumper log X112.4 - X110.4. The plug must connect 1-5	(SMP bus board D10 / p. 25)
D11	31 25 692 J1042	Backplane	Check the fuses/jumpers Jumper log, wiring diagram J1042-31/	(Board D11, backplane / p. 26)
D21	31 25 577 J1042	Power supply M16	Check the fuses, wiring diagram J1042-6A/6B	(Board D 21, power supply M16 / p. 26)
D25	88 21 068 G1005	ECG/QRS separation Dig. mem- ory	Check the fuse, wiring diagram J1042-45 jumper Note: Do not change the potentiometer setting!	n.a.
D26	88 21 068 G1005	Respira- tion Ana- log Gate	Check the jumper, jumper log, wiring diagram J1042-46 Note: Do not change the potentiometer setting!	n.a.
D4	84 37 337 K2013	Power supply D25/D26	Check fuses F1/F2, wiring diagram J1042-44	(Board D4, power sup- ply, respira- tory and ECG triggering / p. 27)

Collimator component N

- Collimator N is maintenance-free and should be replaced in the event of a mechanical malfunction. An adjustment test must be performed following replacement ([Replacing electric components / p. 28](#))).
- In case of electronics errors, parts will be replaced according to spare parts list RX74-020.081.10....

VIDEOMED DI-M component

When servicing or replacing the VIDEOMED DI-M, adhere to the Service Instructions
RX52-022.061.01...

Board	Part no.	Name	Remarks regarding replacement / tool tips	Info
D1	30 97 727 X2170	Analog board	Remove the resistor between X902 and X903, refer to the service note "Adapting a MEMOSKOP"	(Board D1, ana- log board / p. 30)
D3	30 97 651 X2170	Digital control board	"Load Default Value" is possible the first time only with the switch, not with the service software. Select the LITHOSTAR measurement field; perform a dose rate check; perform an IQ test For 33 cm I.I. only: select horizontal and vertical image reversal	n.a.

Memoskop component

Use Service Instructions RX57-029.061.01... when working on the Memoskop.

Multispot component

Use the Setting Instructions RX57-091.032.01... when working on the Multispot 2000.

Laser light localizer component

The complete laser light localizer unit is replaced. It can be converted from battery operation to rechargeable battery pack operation (refer to Instructions RXL2-120.033.03...).

Unit/control console component

Board	Part no.	Name	Remarks regarding replacement - tool tips	Detail info
D7 ...	89 49 505 G5334	Motor output stage	No special attention necessary	n.a.
D31	31 25 585 J1042	Base frame, distributor board	Check jumper log, wiring diagram J1042-51	n.a.
D32	31 25 676 J1042	Support frame, distributor board	No special attention necessary	(Board D32, distributor board, supporting frame / p. 31)
Z96	31 36 194 X2134	I.I. power supply, operator panel	Check fuses F2 and F3; wiring diagram J1042-6	(I.I. supply Z96 "Röderstein" / p. 31)
n.a.	31 23 879 J1042	Tablesideside control	Completely replaced! check the switch, jumper log, wiring diagram J1042-61	(Table-side control panel (NBF), board D41 / p. 32)
D51	31 25 627 J1042	ADC/DUEP plugin board in the PC	Check jumpers, switches; replace Prom; jumper log, wiring diagram J1042-71	(Board D51, ADC/DUEP plug-in board / p. 33)
r3-6, 8	30 28 009 B0611	Potentiometer	n.a.	(a) Potentiometers / p. 35)

Board	Part no.	Name	Remarks regarding replacement - tool tips	Detail info
am 1/2	70 54 422 F0721	Lifting column	n.a.	(Check- ing / Replac- ing the Lifting Columns R / L / p. 56)
n.a.	31 23 994 J1042	Shock wave release	Replace completely, no special attention necessary	n.a.
n.a.	47 82 707 J1042	System floor switch	Replace completely;	n.a.

Generator component

The following instructions should be used when working on the generator.

LITHOSTAR Multiline	Serial no. \leq 6073		RX63-020.034.12...
	Serial no. > 7000	POLYDOROS SX	RXL2-120.034.05...
	Serial no. > 7000	POLYDOROS LX	RXL2-120.034.02...
	Troubleshooting Instructions	POLYDOROS LX	RX63-020.072.01...
	Troubleshooting Instructions	POLYDOROS SX	RX63-055.072.01...

When replacing the image intensifier, X-ray tube or camera, use the Start-up instructions for the specific component. In addition, adjust the system in accordance with the adjustment instructions, "Isocenter Adjustment" RXL2-120.071.01....

Ultrasound option

Use Start-up Instructions RXL2-120.091.10.01... when working on the ultrasound system.

Component N 11

NOTE

Refer to wiring diagram J1042-3A for the rated current values of the different fuses listed in this chapter.

Board D1, (new type) host computer or when replacing the battery

78 28 841 J 1042, refer to wiring diagram J1042-21-4
30 82 138 battery 3.0 V

Follow items A + B + D when replacing board D1.

Follow items A + C + D when replacing the battery.

- A
- If possible, perform a backup of all current parameters and data.
(Refer to Operation of the Service Software RXL2-120.113.01. Chap. 3-3)
 - Read out the counter values for
 - shock counter generator shock counter shockwave
 - shock counter spark-gap shock counter total
 - shock counter US probe (starting with Rev. 05)and document them in the operating log (Logbook, Reg. 8).
 - Remove board D1 from electronics rack N11.
- B
- Change EMC shielding plate, if present, from old to new board.
 - Set or check the switches on the new board.
 - Switch settings, see wiring diagram excerpt in the Appendix to this manual.
- C
- Measure the battery voltage; $U_{\text{batt}} > 2.7 \text{ V}$ is normal.
 - If the battery voltage is $< 2.7 \text{ V}$, replace the battery.
 - Desolder the old battery and replace it with a new one.
- D
- Measure the battery voltage; $U_{\text{batt}} > 2.7 \text{ V}$ is normal.
 - If the battery voltage is $< 2.7 \text{ V}$, replace the battery.
 - Insert board D1.
 - After switching on the system:

- Establish a connection between the service PC and D1 X10
- Start the service software (Refer to the service software operating instructions RXL2-120.113...)
- Enter the current time and date "Realtime Clock"
- Execute a download of "Host Software, Parameter file" in the Data menu
- Execute a restore of the "Customer Data", "System Data" parameters in the Data menu
- Call up "Technical Info" and "Service Data" in the Info menu with "Load from File" and save by selecting "Put to Unit".
- Call up "Parameters" in the Adjustment menu
- Select "Interface Shockwavesystem" from the Parameter group
- The value 00 must appear in the "Value" column for:
 - Reset shock counter generator / Reset shock counter shockwave
 - Reset shock counter spark-gap / Reset shock counter total
 - Reset shock counter US probe (starting with Rev. 05)
- If necessary, reset the values in the Value column
(Reset with "FF"/normal operation with "00", refer to "Setting the software parameters" RXL2-120.032.01..)

NOTE

The Appendix of this manual contains a layout of the new D1 board. When board D1 is replaced, this layout is to be attached to the LITHOSTAR Multiline wiring diagram.

Board D1, (old type) host computer or when replacing the battery

31 25,825 J 1042, refer to wiring diagram J1042-21-4

31 46 073 B 2905 battery 3.6 V

Follow items A + B + D when replacing board D1.

Follow items A + C + D when replacing the battery.

- A • If possible, perform a backup of all current parameters and data.
(Refer to Operation of the Service Software RXL2-120.113.01. Chap. 3-3)
- Read out the counter values for

shock counter generator	shock counter shockwave
shock counter spark-gap	shock counter total
shock counter US probe (starting with Rev. 05)	

 and document them in the operating log (Logbook, Reg. 8).

- Remove board D1 from electronics rack N11.
- B
- Change EMC shielding plate, if present, from old to new board.
 - Set or check the switches on the new board.
 - Replace Proms J66/J67.
 - Solder in jumper X26 - X27 to activate the battery.
- C
- Measure the battery voltage; $U_{\text{batt}} > 3.0 \text{ V}$ is normal.
 - If the battery voltage is $< 3.0 \text{ V}$, replace the battery.
 - Desolder the old battery and replace it with a new one.
- D
- Measure the battery voltage; $U_{\text{batt}} > 3.0 \text{ V}$ is normal.
 - If the battery voltage is $< 3.0 \text{ V}$, replace the battery.
 - Insert board D1.
 - After switching on the system:
 - Establish a connection between the service PC and D1 X10
 - Start the service software (Refer to the Service Software Operating Instructions RXL2-120.113...)
 - Enter the current time and date "Realtime Clock"
 - Execute a download of "Host Software, Parameter file" in the Data menu
 - Execute a restore of the "Customer Data", "System Data" parameters in the Data menu
 - Call up "Technical Info" and "Service Data" in the Info menu with "Load from File" and save by selecting "Put to Unit".
 - Call up "Parameters" in the Adjustment menu
 - Select "Interface Shockwavesystem" from the Parameter group
 - The value 00 must appear in the "Value" column for:
 - Reset shock counter generator / Reset shock counter shockwave
 - Reset shock counter spark-gap / Reset shock counter total
 - Reset shock counter US probe (starting with Rev. 05)
 - If necessary, reset the values in the Value column
(Reset with "FF"/normal operation with "00", refer to "Setting the software parameters" RXL2-120.032.01..)

Board D4xx, Motor controller

89 49 588 G 5334

Refer to jumper log wiring diagram J 1042-24

- Set or check jumpers
- Check switch S2 (S2 defines the board as D4A, B or C).

NOTICE

PAL modules

⇒ **The PAL modules J5, J31 and J32 on the replacement board must be removed and destroyed. Only the original PAL modules of the old board D4 may be used.**

- Replace Prom J38.
- Mark the board according to its location.
- Insert the board and switch the system on.
- Check the operating voltage at test point X10 +5 V +/- 250 mV (0V, X11).

Board D 5, A/D converter

31 25 528 J1042,

Refer to jumper log, wiring diagram J 1042-25

37 83 714 J1042

NOTICE

Risk of short circuit! Do not use the 96-pin extension board 81 33 944 X1454 to extend the front plug D5.X2.

⇒ **Use only the short 96-pin extension board, part no. 85 73 628 G5206.**

- Remove the front plug X2; remove board D5.
- Set or check jumpers.
- Check the Proms J1/J2 and replace them, if necessary.
- Insert the board and set front plug X2 to the short extension; switch on the system.
- Check the reference voltage $U_{ref} = 5.120 \text{ V} \pm 5 \text{ mV}$ by connecting a DVM to board D5 at Mp X31 - X30 (0V). If necessary, set it with potentiometer R220 on board D8.

Checking the A/D converter

- Measure and record the voltage value for every actual value potentiometer (r1 ... r6) (Mp X10 ... X15).
- Read out and record the value of the **ADC value** for the corresponding potentiometer with the service PC in the Diagnostic, Monitoring menu.

- Ensure that the relevant voltage value corresponds to the **ADC value**.

Conversion:

$$\text{Voltage value (mV)} = \text{ADC value (bit)} \times 5\text{mV/bit} \quad \rightarrow \pm 20 \text{ mV tolerance}$$

$$\text{ADC value (bit)} = \frac{\text{Voltage value (mV)}}{5\text{mV/bit}} \quad \rightarrow \pm 4 \text{ bit tolerance}$$

Example:

Measured value at D5 M_pX = 2935 mV

$$\text{Calculated value ADC value (bit)} = \frac{2935 \text{ mV}}{5 \text{ bit/mV}} = 587 \text{ bit}$$

- Compare with recorded **ADC value**

-> the ADC value in bits for this channel is correct as long as the values do not deviate from one another by more than ± 4 bits.

Check the calculation: $587 \text{ bit} \times 5 \text{ mV/bit} = 2935 \text{ mV} \pm 20 \text{ mV}$

- Switch off the system, remove the extension board and reconnect the front plug X2.
- Switch the system on.
- Check the operation of the various drives.

SMP bus board D10

11 14 839 G5347,

wiring diagram J 1042-30

- Remove the cable connections from module N11.
- Remove the boards according to ESD guidelines and remove module N11 from the cabinet.
- Replace board D10.
- Reinstall module N11 in reverse order.
- When installing the EMC shielding plate, ensure that the cables fit in the recesses provided and are not damaged.

- Attach the exposed cable shielding with clamps.

Starting with serial no. 7001:

Transfer the jumper from the old board to the new board. X112.4 - X110.4

The plug must connect 1-5. (Refer to the jumper log).

Board D11, backplane

31 25 577 J1041, wiring diagram J 1042-31

- Remove the cable connections from module N11.
- Remove the boards according to ESD guidelines and remove module N11 from the cabinet.
- Replace board D11.
- Reinstall module N11 in reverse order.
- When installing the EMC shielding plate, ensure that the cables fit in the recesses provided and are not damaged.
- Attach the exposed cable shielding with clamps.
- Check or set the jumper positions according to the jumper log or wiring diagram.
- Check the fuses F10...F16 according to the wiring diagram.

Board D 21, power supply M16

31 25 577 J1042, wiring diagram J 1042-41

- Check fuses F1 and F2.
- Replace the board.
- Switch the system on.
- Check LEDs V10... V16 and operating voltages.

Supply voltage of the magnetic brakes LED V10

MP	X3.3/4	+25 V to +29 V regulated
Gnd	X3.1/2	

Supply voltage of function switches and safety circuits LED V11

MP	X2.10	+23 V to +26 V regulated
Gnd	X2.6	

Supply voltage of the DUEP interface to the image memory LED V12

MP X2.1 +8.5 to +9.5 V regulated

Gnd X2.2

Supply voltage of the collimator

LED V13

MP X4.4 +27 V to +35 V

Gnd X4.2

Supply voltage of the large drives (K1/K2 are energized)

LED V14

MP X15 +28 V to +35 V

Gnd X14

Supply voltage of the small drives (K3 is energized)

LED V15

MP X17 +28 V to +35 V

Gnd X16

Supply voltage of the Com controller (DUEP)

LED V16

MP X2.9 +14 V to +15.5 V regulated

Gnd X2.6

Board D4, power supply, respiratory and ECG triggering

84 37 337 K2013, wiring diagram J 1042-44

- Check fuses F1 and F2.
- Measure the operating voltage (place the board on the extension)

+ 12 V ± 10%	(X1.d/b/z4)	LED V4	The - 5V are not used in the
- 12 V ± 10%	(X1.d/b/z4)	LED V11	LITHOSTAR Multiline
GND	(X1.d/b/z4)		.

Collimator N

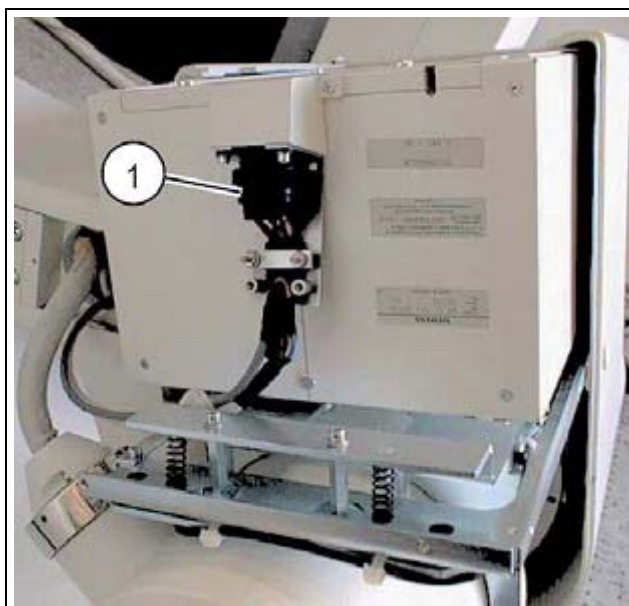


Fig. 1: Strain relief

Replacing the collimator

- Unpack the collimator.
- Remove the two colored screws from the transport bracket on the side of the blades close to the focus.
- Check the adjustment of the leaves close to the focus with the template.
- Attach the collimator to the tube unit.
- If plug X1 has a connector shell, unscrew it, cut it open, remove it.
- Plug the X1 plug into the collimator and bolt it
- Attach the cable at the panel using strain relief clamps ((1/Fig. 1 / p. 28)).
- Perform the adjustment test when you replace the entire collimator.

Replacing electric components

- Switch off the system
- Replace the electric components according to the spare parts list and perform the adjustment test.

D1/S2.5	
OFF	Collimator without prefiltration
ON	Collimator with prefiltration (On D1X7, check that the cable for the drive is connected)

Adjustment test

- Set DIP switch S2.4 to "OFF".
- Close the "height" and "width" collimator blades completely by hand.
- Remove the prefilter (if present).
- Move the iris blades to an opening of 70 x 70 mm (measure at the iris blades).
- Switch the system back on or reinsert fuse F1 on D1.
- Switch DIP switch S2.4 to "ON" for initialization.
The system will initialize. DIP switch S2.4 should remain "ON" during operation.
- The height and width blades will open or close to the 44mm format ($\pm 0.75\%$) x 44 mm ($\pm 0.75\%$) at a SID of 125 cm (35 mm x 35 mm at 100 cm SID).

Control position of the collimator blades

- Install the cassette holder. Do not insert a film cassette.
- Move the system into the mid-range position.
- Release fluoroscopy.
- A radiation field of comparable size
44 mm ($\pm 0.75\%$) x 44 mm ($\pm 0.75\%$) - is visible on the monitor at a SID of 125 cm.

VIDEOMED DI-M component

Board D1, analog board

30 97 727 X2170

wiring diagram X 2170-10

- Starting with revision level 01, the 620 ohm resistor between test points X902 and X903 should be removed.

Board D3, analog board

30 97 651 X2170

wiring diagram X 2170-13

- Select the "Multiline" measurement field from the specific parameters (refer to the Service Instructions RX52-022.061.01...).
- Check the dose setting according to Start-up Instructions RXL2-120.034.01...).
- Perform an IQ test
- For 33 cm I.I. only:
Select "H-image reverse" and "V-image reverse" in the specific parameters and transfer them individually to the system (Refer to the Service Instructions RX52-022.061.01...).

Unit/control console component

Board D32, distributor board, supporting frame

31 25 676 J1042, wiring diagram J1042-52/52A

- Plug in and check the connection cables according to the wiring diagram.
- Check connection (X56) and the operation of the tube assembly fan.
- Check the operation of service switch S 58.
- Check the operation LED's V14 to V18 for the magnetic brake by moving the associated drive (The LED lights up when the brake is released).

I.I. supply Z96 "Röderstein"

31 36 194 X2134, wiring diagram X2134

- Replace the board and the power transistor at the same time.
- Check fuses F2 and F3.
- Check the operating voltage $27\text{ V} \pm 10\%$ for V11 "ON"; $T_p 27\text{ V} \rightarrow T_p 0$.

Tablesideside control panel (NBF), board D41

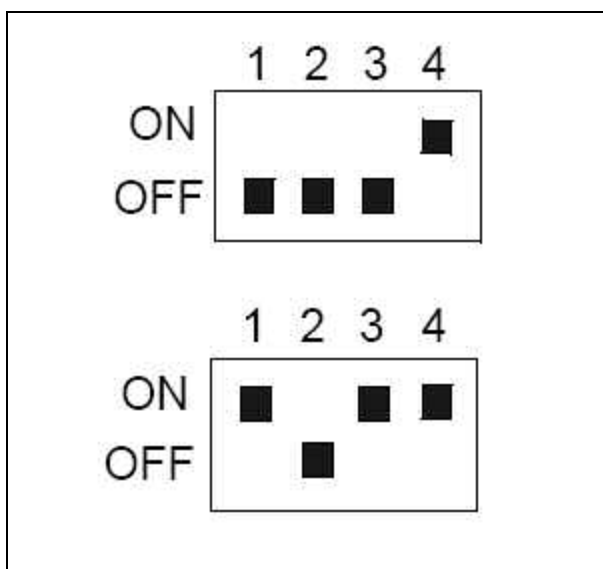
31 23 879 J1042,

wiring diagram J1042-61

Board D41 is coded in the factory to "Patient table basic unit".

Recoding for use on the control console, board D41

- Place the tableside control panel with the membrane keyboard side on a level surface.
- Remove four screws (M 2.5x16) from the lower part of the housing.
- Carefully lift off the lower housing.
Four metal spacers are lying loosely on the PC board.
- Set or check the DUEP slave address of switch S3 according to the application and the wiring diagram:



Address 7: Tableside control panel (NBF) basic unit (patient table) factory setting

Address 2: Tableside control panel (NBF) basic unit control console

Fig. 2: S3 Switch

Assembly

- Center the four metal spacers on the contact surfaces and insert the four screws (M2.5x16) in the holes in the lower part of the housing.
- Join the housing parts together so that one of the screws can be inserted through the hole of the grounding tape.
The metal spacers must not move during assembly.
- Tighten the screws.

System unit

30 10 175 JE002

- Replace the system unit, if necessary, according to the Repair Instructions RXL2-120.091.02... .

Board D51, ADC/DUEP plug-in board

31 25 627 J1042, wiring diagram J1042-71

Refer also to Repair Instructions "Replacement of the system unit" RXL2-120.091...

- Set and check the jumpers and Proms according to the jumper or wiring diagram.
- Check the 7-segment display
(Refer to the error list RXL2-120-072.03...).

Overview of the potentiometers and reference switches

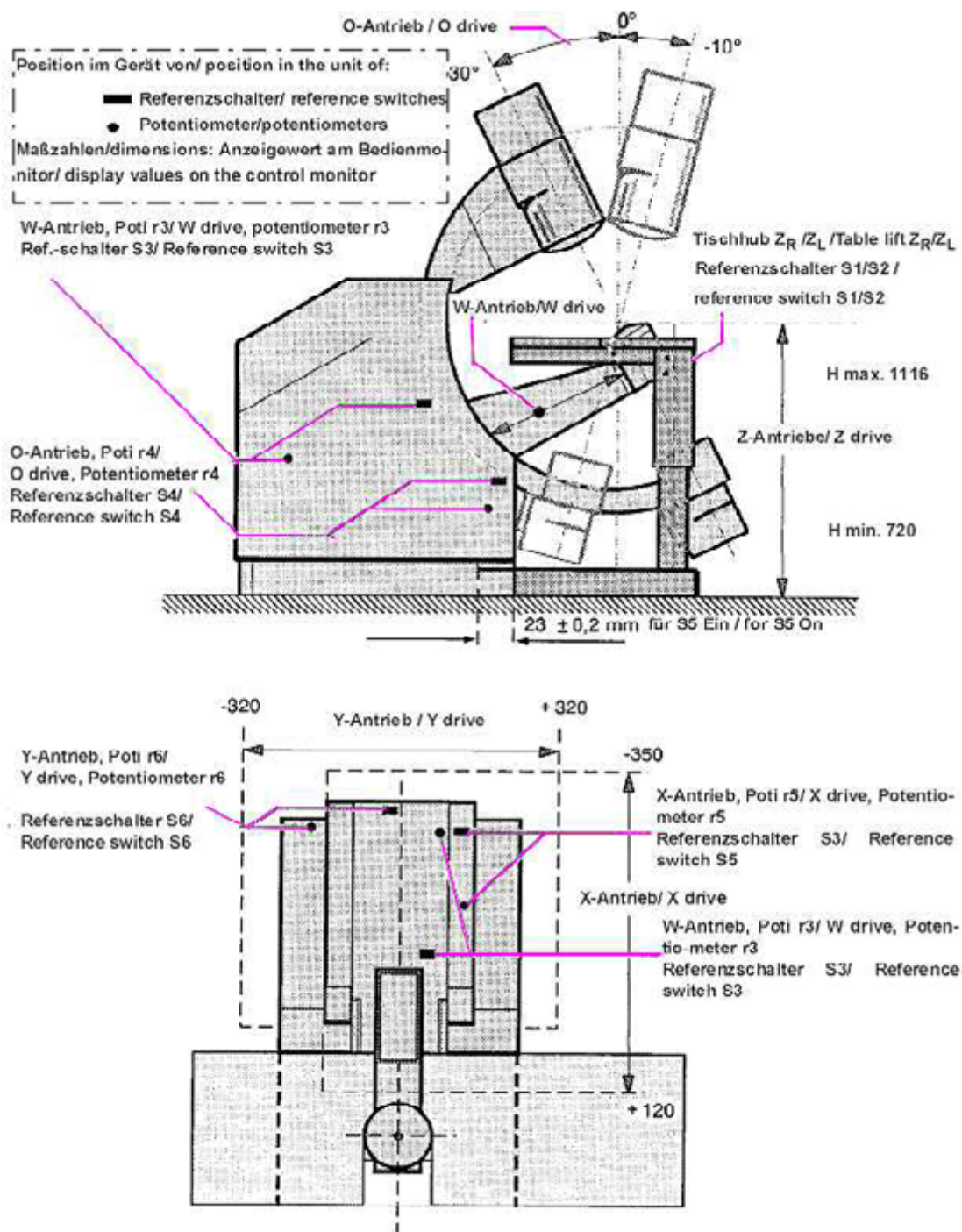


Fig. 3: Overview of potentiometers and reference switches

Basic information on the replacement and adjustment of potentiometers, reference switches and motor encoders

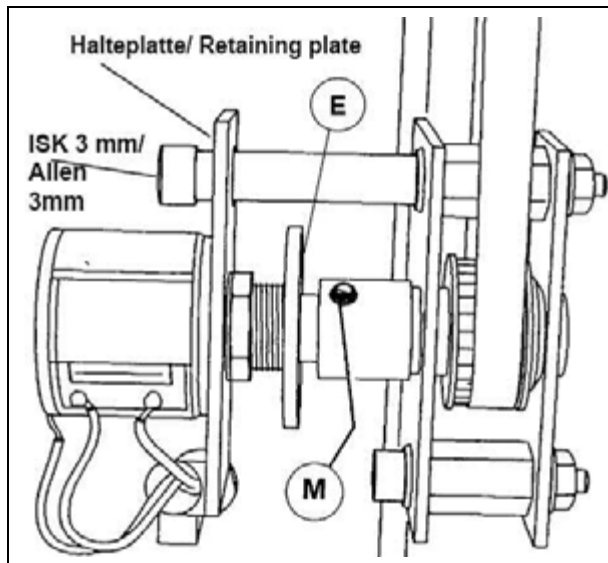


Fig. 4: Replacing the potentiometer

General replacement and adjustment

a) Potentiometers

- Move the unit so that the set screw becomes accessible ((M/ Fig. 4 / p. 35)).
- Switch the system off.
- Remove the Allen 1.5 mm set screw on the connecting piece of the potentiometer shaft ((M/ Fig. 4 / p. 35)).
- Remove the potentiometer retaining plate ((ISK 3 mm/ Fig. 4 / p. 35)).
- Remove the adjustment wheel ((E/ Fig. 4 / p. 35)) and the retaining parts from the potentiometer shaft.
- Desolder the connection wires from the potentiometer and solder them to the new potentiometer in the same order.
- Install the potentiometer in the reverse order. Do not tighten the set screw yet (Allen 1.5 mm).
- Switch the system on.
- Move the drive in "unregulated motion" with the service PC (Adjustment, Calibration) in mm steps so that the corresponding reference switch is actuated (refer to (Fig. 5 / p. 36)). Check with DVM at D5.X2.A1...A11, 0V=X30.

NOTE

The potentiometer values are set in accordance with ADC values.

- Exit "unregulated motion" and select the "ADC value" for the corresponding drive in Diagnostic, Monitoring.

- Set the ADC value to the corresponding value using the adjustment wheel ((E/Fig. 4 / p. 35)) (Refer to the detailed description for the corresponding potentiometer).
- Retighten the set screw on the potentiometer shaft.
- Reset board D1 with S1.
- Check the drive function. No errors may be displayed.
- If reference switch errors continue to be displayed after adjusting the potentiometer (Errors 0020-002B), check the A/D converter on board D5 according to (Board D 5, A/D converter / p. 24).

b) Reference switches

NOTE

A 24 V lamp may be used to check switch functions instead of an oscilloscope.

- Switch the system off.
- Remove the reference switch in question and remove the switch rocker.
- Replace the switch and wire.
- Reinstall the switch with the switch rocker and check the operation of the switch rocker.
- Switch the system on.

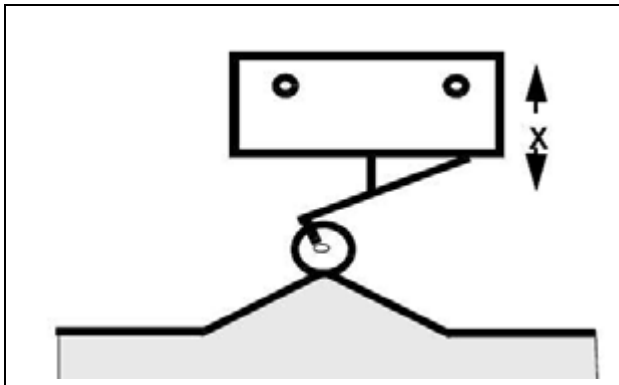


Fig. 5: Replacing the reference switch

Connect an oscilloscope (or lamp ≥ 24 V) to the input of board D5 X2 a... to check the reference switch function (GND: X30/X40) (refer to the Overview circuit diagram for the respective reference switch J1042-8...).

- Move the corresponding drive far enough so that the reference position is reached on the service PC (Diagnostic; Monitoring) (Refer to the chapter on adjusting the drives).
- Adjust the reference switch by moving it in the X direction. The switch should activate within the mechanical limits of the switching hysteresis ((Fig. 5 / p. 36)).

Check it using the service PC (Diagnostic; Monitoring; Refswitch; Y; X; 0; W; ZL; ZR; TL; TR) or on the oscilloscope (lamp ≥ 24 V).

Move the drive over the reference switch position several times to check.

- Check the drive function.
- Move the activator of the drive up to approx. 1 cm in front of the reference switch.

- Continue to move toward the switch in inching mode ((Fig. 5 / p. 36)).
In addition, check the status of the reference switch on the service PC (Diagnostic, Monitoring).
- If the switch is activated from both sides, check the switching hysteresis for both sides.
No errors may be displayed.

Overview of the switching hysteresis

- The test points of the actual value potentiometers and reference switches on board D5 are shown in the wiring diagram J1042-8x.

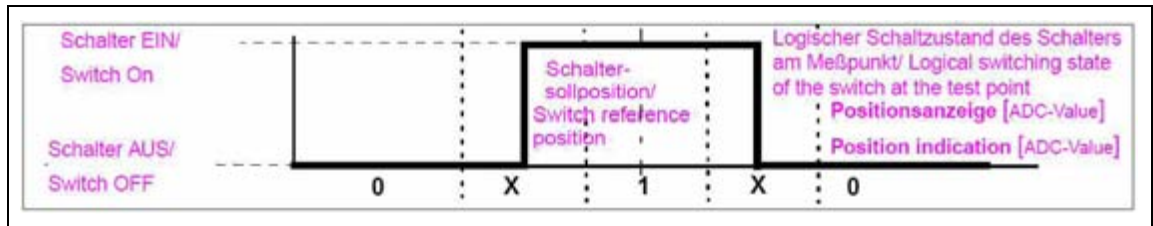


Fig. 6: Overview of the switching hysteresis

The switch can be ON or OFF within the range "X".

For the actual value potentiometers and reference switch test points on board D5, refer to wiring diagram J1042-8x.

c) Checking synchronization of the actual value potentiometers to the motor encoder

NOTE

Starting with software VA00D (Software Upgrade Rev. 3), the physical limits of the drive are monitored.

Adjustment of the MC position with the ADC position

- When the system is switched ON or board D1 is reset with button S1, the value of "MC position" is adjusted to the value of the "ADC position." (initialized).
- If the ADC position deviates from the MC position, the error "428x AD / MC position comparison failure / x" is displayed (x corresponds to the number of the drive).

Reason for the error message

- Potentiometer Actual value Rx not synchronous to the motor encoder Bx.

Maximum acceptable differences in the ADC/MC positions

ZL, ZR = 25 in 1/10 mm W = 30 in 1/10 mm X = 30 in 1/10 mm Y = 30 in 1/10 mm

O = 90 in 1/100° TL = 18 in 1/10 mm TR = 175 in 1/100°

Checking the display for the corresponding drive in the service PC

"MC position" and "ADC position" are displayed on the service PC (Diagnostic, Monitoring).

- Move the respective drive into an end position.
- Reset board D1 with button S1.

- Check the respective adjustment for the drive ("MC position" to "ADC position") on the service PC (Diagnostic, Monitoring).
- Move the drive to the opposite end stop in 5 steps.
- Perform a check at the service PC.

NOTE

If the deviations of the ADC/MC positions are greater than the maximum acceptable deviations, the drives must be checked. If there are errors in the lifting columns and/or the cone drive, they must be replaced, since the actual value potentiometer cannot be adjusted.

Procedure for tensioning the toothed belt:

- Loosen the screws at the idler pulley of the corresponding potentiometer toothed belt.
- Tighten the toothed belt by shifting the idler pulley and retighten the retaining plate.
- Reset board D1 with button S1.
- Perform a functional check as described above.
- Loosen the idler pulley again if shifting the idler pulley does not adjust the belt adequately.
- Remove the retaining plate for the toothed belt end stop.
- Open the clamping piece of the toothed belt, shorten the belt by removing 4 teeth (2 teeth each parallel), insert the belt and reassemble completely.
- Perform a functional check as described above (check hysteresis of the reference switch).

Error display:

„Antriebe stehen außerhalb der physikalischen Betriebsgrenzen"

"Drives are located outside of physical limits"

"Moteurs endehors des limites physiques"

"Los Motores se encuentran fuera de los limites fisicos"

Error Cause:

- One of the drives (O, W, X, Y, Z, TL, TR) is in the ADC position in the area of the hardware proximity switch outside the operating range (Monitoring) (ZL, ZR = 50 in 1/10 mm; W, X, Y = 40 in 1/10 mm; O = 100 in 1/100°; TL = 20 in 1/10 mm; TR = 400 in 1/100°)

Remedy:

- Check the respective drive using the service PC (Diagnostic, Monitoring).
- Move the drive into the mid-range position (inside the operating limits) in "unregulated mode" (Avoid collisions).
- Reset board D1 with button S1.
- Perform a functional check. If necessary, repeat the check of the display ("MC/ADC position") for the corresponding drive in the service PC. If there is no improvement, adjust the toothed belt.

Error display:

„Gerät befindet sich außerhalb der Betriebsgrenzen“

"Unit is outside the operating limits"

"L appareil est en dehors des limites d utilisation"

"Equipo se halla fuera de los limites de servicio"

Error Cause:

- After exiting service mode "Unregulated motion" or
- when changing the Uro table, (switching over from **Lithotripsy mode** <-> **Urology mode**) O, W, X, Y, Z, TL, TR
- At least one drive is outside the respective operating limits. (Refer above for the drive values)

Remedy:

- Move drives to the basic position or ascending position (inside the operating limits) using the →**0**← button.
- Perform a functional check. If necessary, repeat the check of the display ("MC/ADC position") for the corresponding drive in the service PC.

Checking, replacement and/or adjustment

Reference switches S3..6, S8, S9 or actual value potentiometers r3..6, r8, r9

NOTICE

Danger of collision!

- ⇒ **Move the drives to a mid-range position to avoid collision when moving the system in "unregulated motion" mode.**
 - ⇒ **The shock wave head (W drive) is in the park position!**
-

Make the following preparations according to the respective work step:

- Connect the service PC to board D1 X10.
- The ADC values, position values and reference switch settings can be read out in the "Diagnostic, Monitoring" menu.
- As an alternative, you can proceed as follows:
 - Remove the EMC shielding plate at the front of N11.
The test points on board D5 are now accessible from the front.
The test points of the ACTUAL value potentiometers are shown in wiring diagram J 1042-25.
 - Remove the front plug X2 of board D5 and reconnect it using the short 96-pin extension board 85 73 628 G5206.
(service accessory for the engineer).

Cone drive TL, reference switch S8 and potentiometer r8

- Connect an oscilloscope to D5.X2.a21 (for S8) (0 V to X30); 5 V/div., 0.1 s/div.
- Switch the system on.
- Move the shock wave head into the therapy position.
- Check the reference voltage, if necessary set it with R220 on D8. ($U_{\text{ref}} = 5.120 \text{ V} \pm 5 \text{ mV}$; check on D5 MP X31, 0V at X30) ADC Value = 102

NOTICE

Changing the reference voltage

⇒ When changing the reference voltage D5 $U_{\text{ref}} = 5.120 \text{ V} \pm 5 \text{ mV}$, check the switching hysteresis for all drives.

- Connect the DVM to D5.X2.a22 (0 V at X30).
- Check the function of potentiometer r8.
- Perform the check in normal mode.
- Check the potentiometer voltage at reference switch S8 = "On". $U_{\text{ref}} = 512 \text{ mV} \pm 5 \text{ mV}$ at D5.X22 and 0 V at D5.X30; ADC value = 102
- Check the switching hysteresis of reference switch S8 according to (Fig. 7 / p. 41) in "Monitoring".

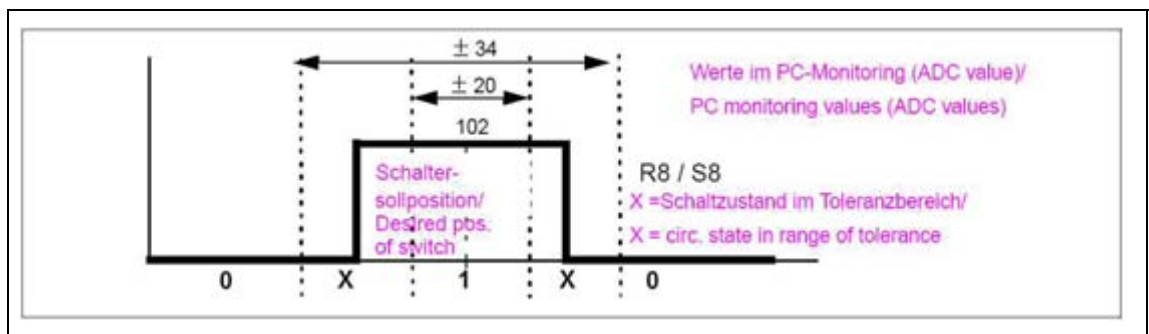


Fig. 7: Switching hysteresis S8

Checking the toothed belt

- Check the toothed belt according to Service Instructions Shock Wave System RXL2-120.841.01.

Checking the travel range

- The shock wave head is in the therapy position.
- The C-arm is in the + 30° fluoroscopy position.



- Release fluoroscopy FL.
 - ⇒ The cone drive moves to the front end position. Safety limit switch S40 must **not** be activated.
 - ⇒ The service PC (Diagnostic, Monitoring) display indicates: ADC value = MC position 600 ± 1 bit.
- Release a shock wave.
 - ⇒ The cone drive travels back to MCESWL position 470 ± 1 bit.
- Uncouple the W drive.
- The cone longitudinal drive travels
 - Cone drive serial no. < 2000 to the MC position 300 ± 1 bit
 - Cone drive serial no. > 2000 to the MC position 360 ± 1 bit

Checking the travel range with US probe (optional)

Prerequisite: - US probe inserted - Shock wave head in therapy position

- Use the cone longitudinal forward button on the US tableside control panel to move the cone drive to the front end position.
 - ⇒ The LED on the US tableside control panel lights up.
 - ⇒ The service PC (Diagnostic, Monitoring) display indicates: ADC value = MC position 600 ± 1 bit.
- Release shock waves.
 - ⇒ The cone drive travels back to MCESWL position 470 ± 1 bit.
- Use the cone longitudinal back button to move the cone drive to the back end position.
 - ⇒ The LED on the US tableside control panel lights up.

Cone drive TR, reference switch S 9 and potentiometer r9

NOTE

Only perform if the ultrasound option is available.

- Connect the oscilloscope to D5.X2.a23 (for S9) (0 V to X30); 5 V/div, 0.1 s/div.
- Switch the system on.
- Move the shock wave head into the therapy position.
- Check the reference voltage, if necessary set it with R220 on D8. ($U_{ref} = 5.120 \text{ V} \pm 5 \text{ mV}$; check on D5 MP X31, 0V at X30)

NOTICE

Changing the reference voltage

⇒ When changing the reference voltage D5 $U_{ref} = 5.120 \text{ V} \pm 5 \text{ mV}$, check the switching hysteresis for all drives.

- Connect a DVM to D5.X2.a24 (0 V at X30).
- Check the function of potentiometer r9.
- **Prerequisite:** US probe not inserted.
- Move to the reference position in Normal mode using the tableside control panel.
Use the "Cone rotation right or left" key for this.
 - ⇒ The cone rotation drive travels to the 0° position and stops.
 - ⇒ The 0° marks on the toothed ring and the lifting cylinder line up.
(If in "unregulated motion" mode, readjust the cone rotation)
 - ⇒ The position is displayed on the US tableside control panel.
- When reference switch S9 is actuated, the DVM should display a reading of $2.560 \text{ V} \pm 2 \text{ mV}$. ADC value = 512
- Check the switching hysteresis of the reference switch S9 according to (Fig. 8 / p. 43).

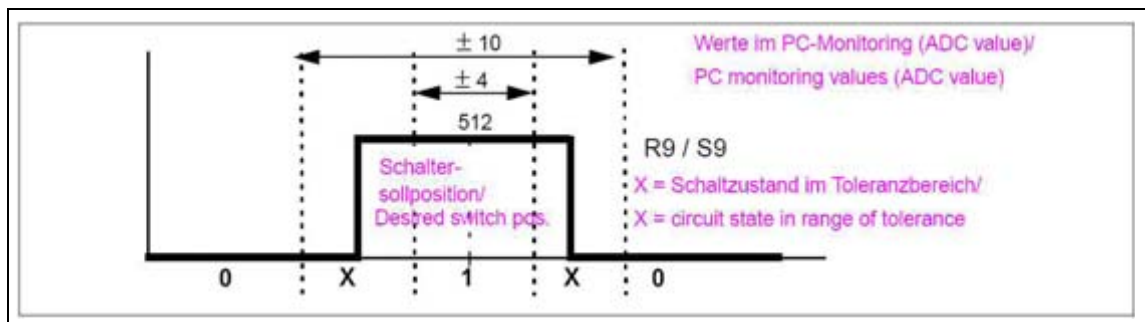


Fig. 8: Switching hysteresis S9

Setting the parameters

Refer to the "Parameter Groups" section of the "Service software, Software parameter / Monitoring" instructions RXL2-120.032.02..

Checking the travel range

Prerequisite: US probe is inserted.

- Move the US probe +90° and -90° by pressing the "Cone rotation left or right" key.
- Check the angular position on the US tableside control panel display.
- Safety limit switch S42 must not be actuated in the $\pm 90^\circ$ setting.

Longitudinal system Y drive

Adjusting belt tension

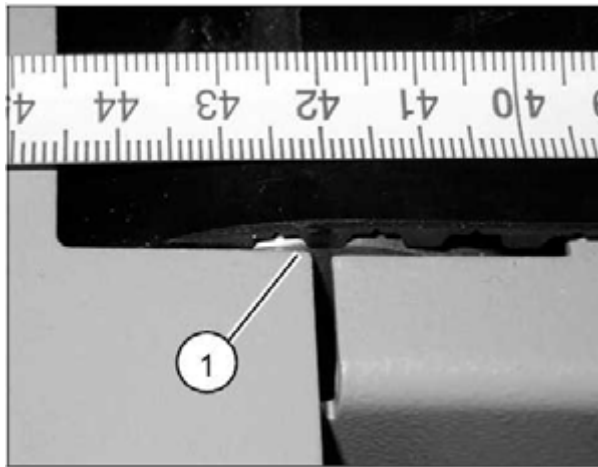


Fig. 9: Measurement_1

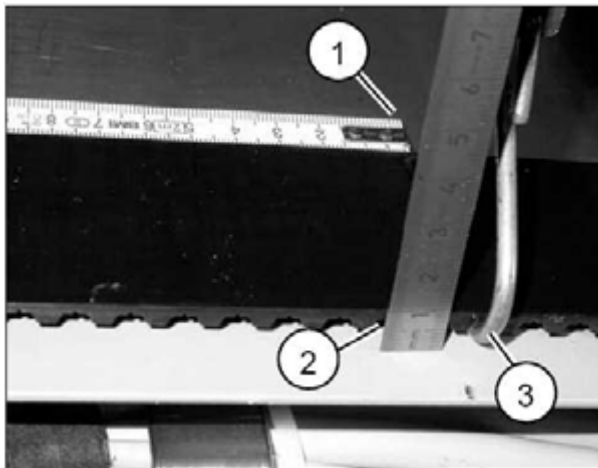


Fig. 10: Measurement_2

- Move the unit left to the end stop.
- The distance from the center of roller (1/Fig. 9 / p. 45) to the end stop (1/Fig. 10 / p. 45) is $420 \pm 5\text{mm}$.
- Attach the spring balance (3/Fig. 10 / p. 45) and lift it with a force of $20\text{ N} + 5\text{ N}$.
- It must be possible to raise the belt $3\text{ mm} + 1\text{ mm}$ (2/Fig. 10 / p. 45).
- If the belt tension varies from this, readjust it.

Adjusting reference switch S6 (Prerequisite: potentiometer r6 functioning correctly)

- Remove the cover of the cable inlet.
- Remove the metal shutter on the left and right at the back of the unit base frame.
- Switch the system on.
- Move the Y drive in inching mode to display "00" on the control monitor or on the service PC (Diagnostic, Monitoring) Y Length ADC position in 1/10mm display to "000".

- Adjust the reference switch S6 so that switching is assured within the stated tolerance range indicated (refer to (Replacing reference switches) and (Switching hystereses S6)).
- Reset the system on board D1 with S1.
- Move the drive over the reference switch position several times to check.

Replacing reference switch S6 and potentiometer r6

Switch adjustment

- Switch the system on.
- Bring the orbital drive into approx. 0° position.
- Bring the X drive into the mid-range position.
- Bring the shock wave head (W drive) into the park position.
- Select "unregulated motion" mode for the Y drive.
- Approach number 3 of the 5 reference points on the back of the unit base frame from the left.

(Reference edge is the right outer side of the cable inlet, refer to (Fig. 11 / p. 46)).

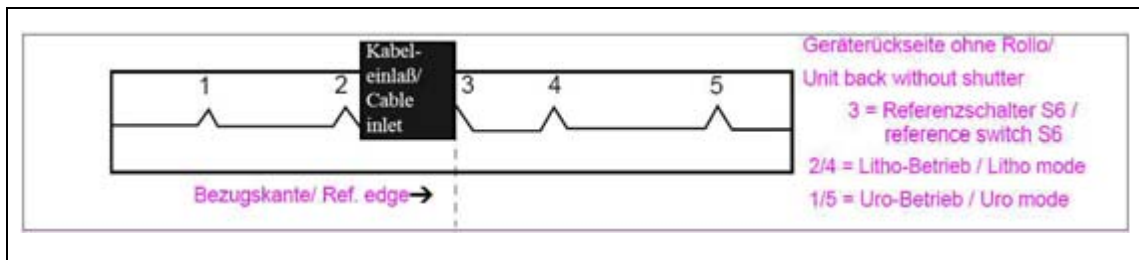


Fig. 11: Reference edge

- Align the reference edge and the reference mark.
- Replace reference switch S6 (refer to (b) Reference switches / p. 36)).
- Check the potentiometer voltage for reference switch S6 = On $U_{REF} = 2.560 \text{ V} + 2 \text{ mV}$ (D5.X15 0V = D5 X30) ADC value = 512.

NOTICE

Changing the reference voltage

⇒ When changing the reference voltage D5 $U_{ref} = 5.120 \text{ V} \pm 5 \text{ mV}$, check the switching hysteresis for all drives.

After replacement or for potentiometer deviations:

- If needed, replace the potentiometer according to (a) Potentiometers / p. 35).
- Reference switch **is** adjusted and closed.
- Loosen the set screw on potentiometer R6.
- Set the potentiometer value to ADC value = 512 by turning the adjustment wheel ((E/ Fig. 4 / p. 35)).
- Tighten the set screw.
- Reset board D1 with button S1.

- Check the switching hysteresis of the reference switch S6 according to (Fig. 12 / p. 47).

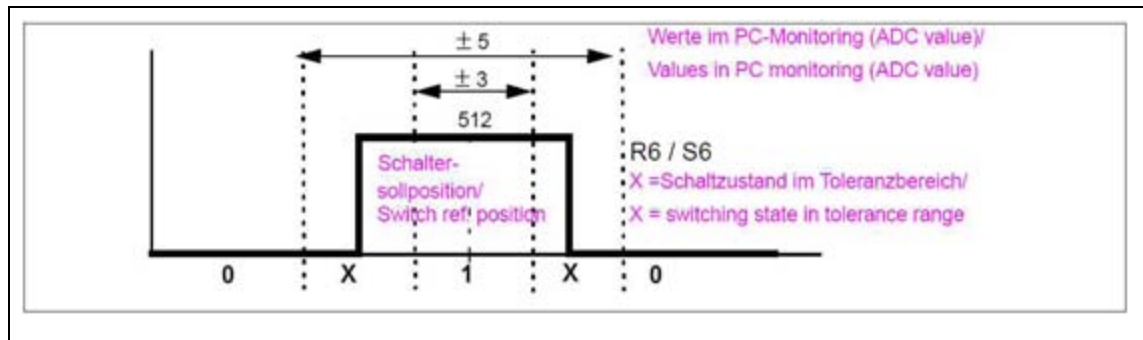


Fig. 12: Switching hysteresis S6

- Move to the end positions on the left or right in the Uro mode.
 - The safety limit switches S64/S65 must not be activated.
 - The unit movement must stop on the left at $-320 \text{ mm} \pm 2 \text{ mm}$ and on the right at $+320 \pm 2 \text{ mm}$ (control monitor display).
- Move to the left or right end positions in Litho mode (shock wave head in therapy position). The safety limit switches S76/S77 must not be activated.

The unit movement must stop on the left at $-25 \text{ mm} \pm 2 \text{ mm}$ and on the right at $+25 \pm 2 \text{ mm}$ (control monitor display).
- If necessary, reattach the metal shutter on the left and right onto the back of the base frame.

When doing this, be sure to correctly position the mounting holes and to use the upper threads of the metal shutter.
- Reattach the cover of the cable inlet.

Transverse system, X drive

Adjusting belt tension

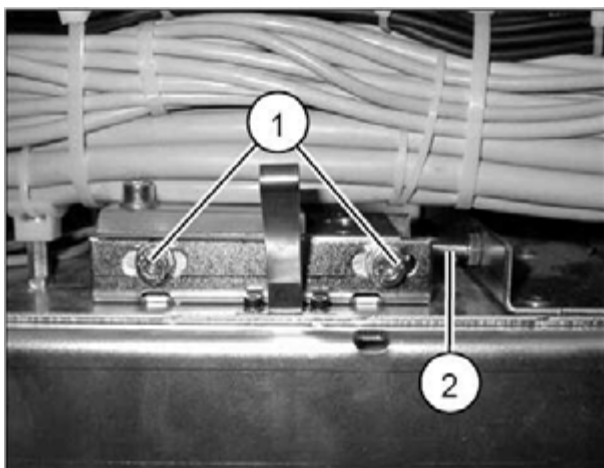


Fig. 13: Screws

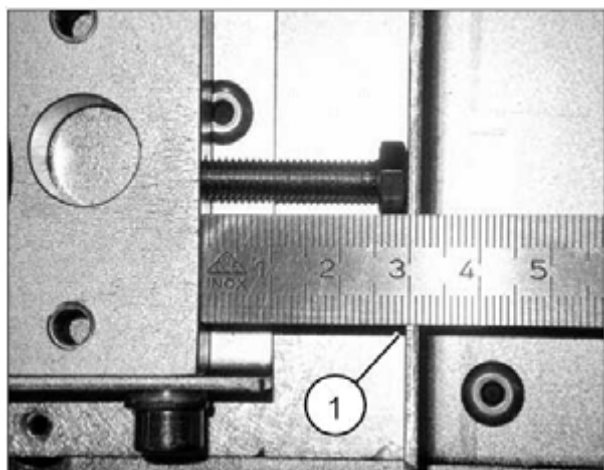


Fig. 14: Reference value

(Checking the belt tension with a spring balance is not possible when the system is assembled)

- The unit should not have any play transversally to the patient.
- To readjust, loosen the 4 fastening screws (1/Fig. 13 / p. 48) (two screws are not visible) and adjust with the adjustment screw ((2/Fig. 13 / p. 48)); reference value for adjustment: 30 mm ((1/Fig. 14 / p. 48)).
- Retighten the 4 mounting screws (1/Fig. 13 / p. 48).

Adjusting reference switch S5

(Prerequisite: potentiometer r5 functioning correctly)

- Switch on the system.
- Move the X drive in inching mode to display "20" mm on the control monitor or on the service PC (Diagnostic, Monitoring) X Length ADC position in 1/10mm display to "200".
- Adjust the reference switch S5 so that switching is assured within the stated tolerance range (refer to (Fig. 5 / p. 36)).

- Reset the system on board D1 with S1.
- Move the drive over the reference switch position several times to check.

Replacing reference switch S5 and potentiometer r5

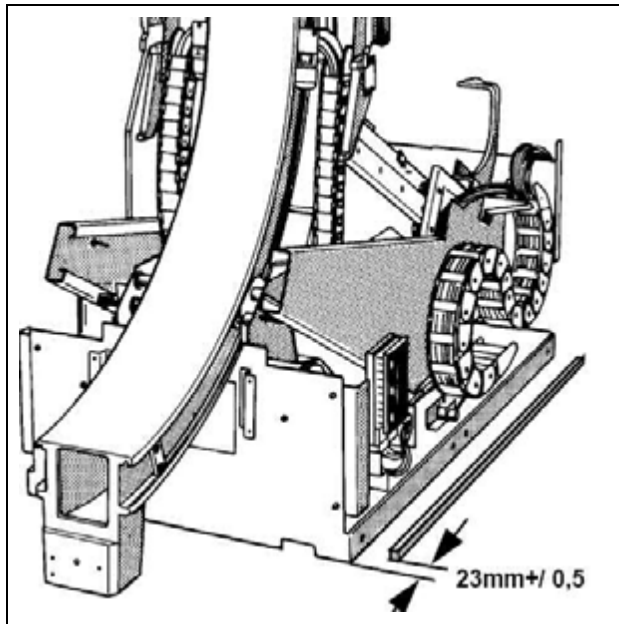


Fig. 15: Transverse system_X_drive

- Switch the system on.
- Bring the orbital drive into approx. 0° position.
- Bring the Y drive into the mid-range position (basic system).
- Bring the shock wave head (W drive) into the park position.
- Select "unregulated motion" mode for the X drive.
- Move the unit carrier to the front far enough so that the front edge of the front plate is 23 mm \pm 0.5 mm in front of the rail edge. ((Fig. 15 / p. 49))
- Replace reference switch S5 (refer to (b) Reference switches / p. 36)).

Check the potentiometer voltage for reference switch S5 = On; $U_{ref} = 3.900 \text{ V} + 2 \text{ mV}$ at D5.X14 and 0V at D5.X30. ADC value = 780

NOTICE

Changing the reference voltage

⇒ When changing the reference voltage D5 $U_{ref} = 5.120 \text{ V} \pm 5 \text{ mV}$, check the switching hysteresis for all drives.

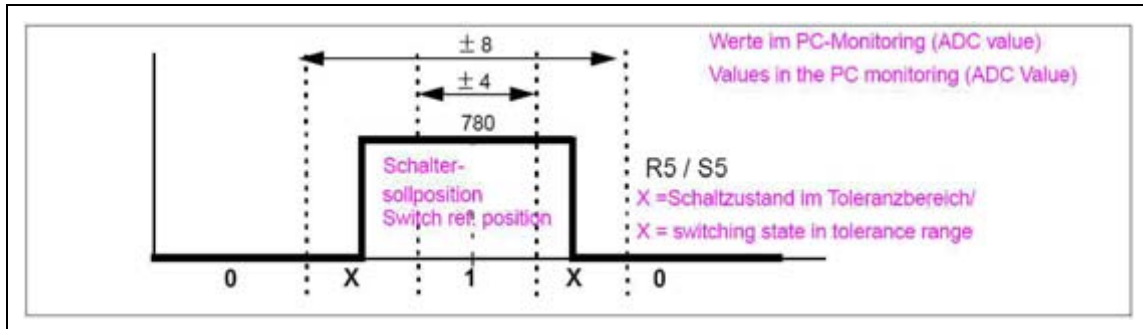


Fig. 16: Switching hysteresis S5

After replacement or for potentiometer deviations:

- Replace the potentiometer according to [\(a\) Potentiometers / p. 35](#)).
- Reference switch **is** adjusted and closed.
- Loosen the set screw on potentiometer R5.
- Set the potentiometer value to ADC value = 780 by turning the adjustment wheel ([\(E/Fig. 4 / p. 35\)](#)).
- Tighten the set screw.
- Reset board D1 with button S1.
- Check the switching hysteresis of reference switch S5 according to [\(Fig. 16 / p. 50\)](#) Fig. 9.
- Move to the front or back end positions in Uro mode.
 - The safety limit switches S67/S66 must not be activated.
 - Unit movement must stop at the front at $+120 \pm 2$ mm and at the back at -350 ± 2 mm.
(control monitor display).
- Move to the back end position in Litho mode (shock wave head in therapy position).
 - The safety limit switch S78 must not respond
 - Restricted unit movement must stop at -30 ± 2 mm to the back.
(control monitor display).

C-arm orbital drive

Adjusting belt tension

- The adjustment of the belt tension is described in "Working on the orbital drive" ([Working on the Orbital Drive / p. 63](#)) in this manual.

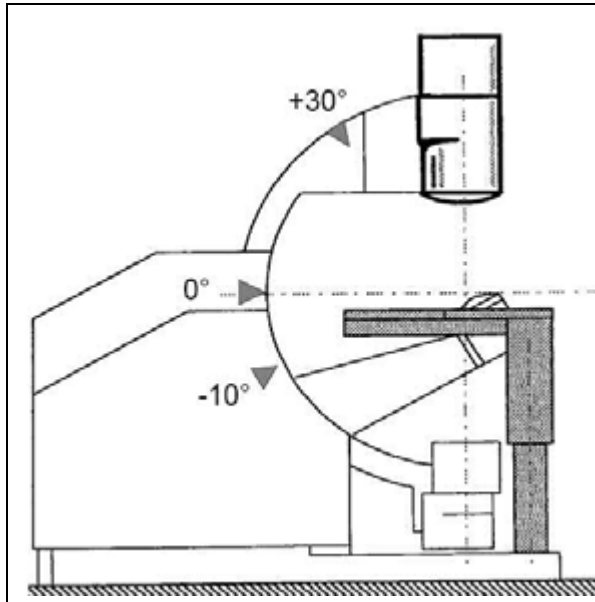


Fig. 17: C_arm_orbital

Adjusting the S4 reference switch

(Prerequisite: potentiometer r4 functioning correctly)

- Switch the system on.
- Move the orbital drive in inching mode to the mechanical indicator "+ 30°" on the service PC (Diagnostic, Monitoring); and the C-arm to the ADC position in 1/10 mm display to "+ 3000".

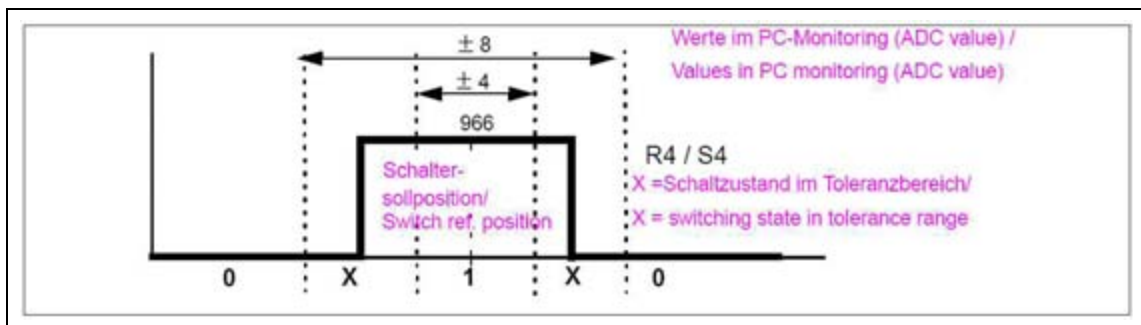


Fig. 18: Adjusting S4

- Adjust reference switch S4 so that switching is assured within the stated switching hysteresis tolerance range (refer to ([Fig. 5 / p. 36](#)) and ([Fig. 18 / p. 51](#))).
- Reset the system on board D1 with S1.
- Move the drive over the reference switch position several times to check.

Replacing reference switch S4 or potentiometer r4

- Connect a DVM to D5.X13 (0 V an X30).
- Connect an oscilloscope to D5.X2.a7 (0 V to X40) ; 5 V/div, 0,1 s/div.
- Switch the system on.
- Bring the X drive and the Y drive into mid-range position.
- Bring the shock wave head (W drive) into the park position.
- Select "unregulated motion" mode for the O drive.
- Bring the arm into +30° position.
- Align the reference edge of the unit cover and the reference mark (arrow) ((Fig. 17 / p. 51)).
- Replace reference switch S4 (refer to (b) Reference switches / p. 36)).
- Check the potentiometer voltage for the reference switch S4 = On $U_{REF} = 4.830 \text{ V} \pm 2 \text{ mV}$ (D5.X13 0V = D5 X30) ADC value = 966

NOTICE**Changing the reference voltage**

⇒ **When changing the reference voltage D5 $U_{ref} = 5.120 \text{ V} \pm 5 \text{ mV}$, check the switching hysteresis for all drives.**

After replacement or for potentiometer deviations:

- If necessary, replace the potentiometer according to (a) Potentiometers / p. 35).
- Reference switch **is** adjusted and closed.
- Loosen the set screw on potentiometer R4.
- Set the potentiometer value to ADC value = 966 by turning the adjustment wheel ((E/Fig. 4 / p. 35)).
- Tighten the set screw.
- Reset board D1 with button S1.
- Check the switching hysteresis of the reference switch S4 according to drawing ((Fig. 18 / p. 51)).
- Move to the +30° or -10° end position with the tableside control.
 - The safety limit switches S70/S71 must not be activated.
 - When the 0° position keys on the tableside control are activated, the orbital drive moves into the vertical position (check the position indicated on the control monitor and at the reference mark).
 - Fluoroscopy is enabled in the + 30° / 0° / -10° positions.

Shock head mount W system

Adjusting belt tension

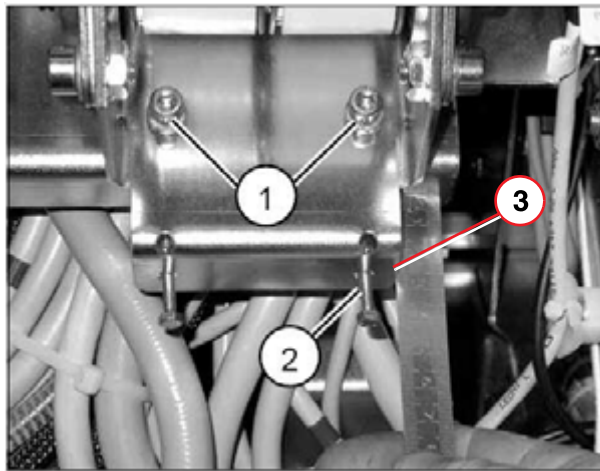


Fig. 19: Adjusting belt tension

- Move the W drive to the uppermost position.
- Switch the system off.
- Loosen the 4 fastening screws ((1/ Fig. 19 / p. 53)) (two screws are not visible) and set a value of 28 mm ((2/ Fig. 19 / p. 53)) with the two adjustment screws ((3/ Fig. 19 / p. 53)).
- Retighten the 4 mounting screws.

Adjusting reference switch S3 and potentiometer r3

- Switch the system on.
- Move the shock wave system into the therapy position.
- Attach the adjustment phantom (switch S28 has switched).
- Check the isocenter in the + 30 degree or - 10 degree position and, if necessary, adjust according to the "Isocenter adjustment" instructions "RXL2-120.071.01...."
(Perform only the work necessary for shock head replacement).

NOTICE

Isocenter

⇒ **The isocenter is the starting point for the adjustment of the reference switch or of the actual value potentiometer.**

- Adjust reference switch S3 so that switching is assured within the stated switching hysteresis tolerance range (refer to (Fig. 5 / p. 36) and (Fig. 20 / p. 54)).

The shock wave head is located in the isocenter.

Replacing reference switch S3 and potentiometer r3

- Switch the system on.
- Bring the X drive and the Y drive into mid-range position (basic position)..
- Bring the orbital drive into +30°.
- Select "unregulated motion" mode for the W drive.

- Bring the shock head into the therapy position.
- Attach the adjustment phantom and adjust the isocenter (refer to Isocenter Adjustment RXL2-120.071.01...)
- Replace reference switch S3 (refer to (b) Reference switches / p. 36)).
- Check the potentiometer voltage for reference switch S3 = ON; $U_{ref} = 4.770 \text{ V} \pm 2 \text{ mV}$ (D5.X12 0V = D5.X30) ADC value = 954.

NOTICE**Changing the reference voltage**

⇒ When changing the reference voltage D5 $U_{ref} = 5.120 \text{ V} \pm 5 \text{ mV}$, check the switching hysteresis for all drives.

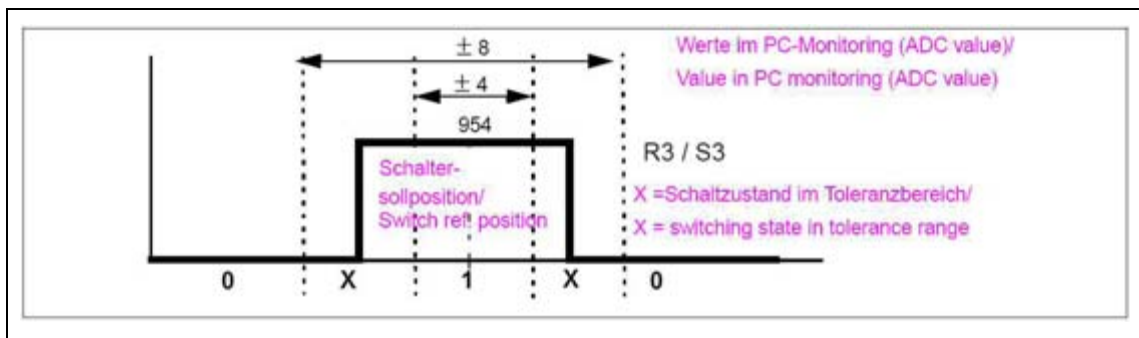


Fig. 20: Replacing S3

After replacement or for potentiometer deviations:

- If necessary, replace the potentiometer according to (a) Potentiometers / p. 35).
- Reference switch **is** adjusted and closed.
- The shock wave system is in the adjusted isocenter.
- Loosen the set screw on potentiometer R3.
- Set the potentiometer value to ADC value = 954 by turning the adjustment wheel ((E/Fig. 4 / p. 35)).
- Tighten the set screw.
- Reset board D1 with button S1.
- Remove the adjustment device (switch S28 is open).
- Check the switching hysteresis of reference switch S3 according to (Fig. 20 / p. 54).
- Move to the "Coupling or park position" end positions.
 - The safety limit switches S69/S68 must not be activated.
- Check the isocenter according to "Isocenter adjustment" RXL2-120.071.01....
- Check the Litho park position S79 (release of the X/Y travel range for Uro mode).
- Move to the park position of the W drive; contact S79 must be closed. If necessary, check "Switch ON" with the DVM on board D32 X41 PIN 3 and at ground GND.
- Install the URO insert.
- Move to the basic →0← position.

- The system may now be moved outside the "Litho Position". ($X = -130 / + 70$; $Y = \pm 320$)
- Safety limit switches S 76/77 as well as S 78 must not be activated.
(Refer to circuit diagram J1042-7).
- Remove the Uro insert and move to the $\rightarrow 0 \leftarrow$ basic position.
The system will only allow travel in the "Litho Position".
- Move the W drive out of the park position.
Switch S79 must open in the MC position - 430 ± 2 mm and switches S 76; S77; S78 must be activated. If necessary, check "Switch ON" with the DVM on board D32 X41 PIN 3 and at ground GND.

Checking potentiometers r1/r2 and reference switches S1 and S25

- Connect an oscilloscope to D5.X2.a1/a3 (for S1/2) (0 V at X30); 5 V/div, 0.1 s/div.
- Switch the system on.
- Install the Uro insert.
- Check the reference voltage, if necessary set it with R220 on D8. ($U_{ref} = 5.120 \text{ V} \pm 5 \text{ mV}$; check on D5 MP X31, 0V at X30)

NOTICE

Changing the reference voltage

⇒ When changing the reference voltage D5 $U_{ref} = 5.120 \text{ V} \pm 5 \text{ mV}$, check the switching hysteresis for all drives.

- Connect a DVM to D5.X2.a2/a4 (0 V at X30).
- Check the functions of potentiometers R1/2.
- Perform the check in normal mode.
- Adjust the table height with the tableside control (NBF).
- Check the potentiometer voltage at reference switches S1/2 = "On" $U_{ref} = 3.710 \text{ V} \pm 2 \text{ mV}$ at D5.X10/X11 and 0 V at D5.X30. ADC value = 742
- Check the switching hysteresis of the reference switch S1/2 according to (Fig. 21 / p. 56).

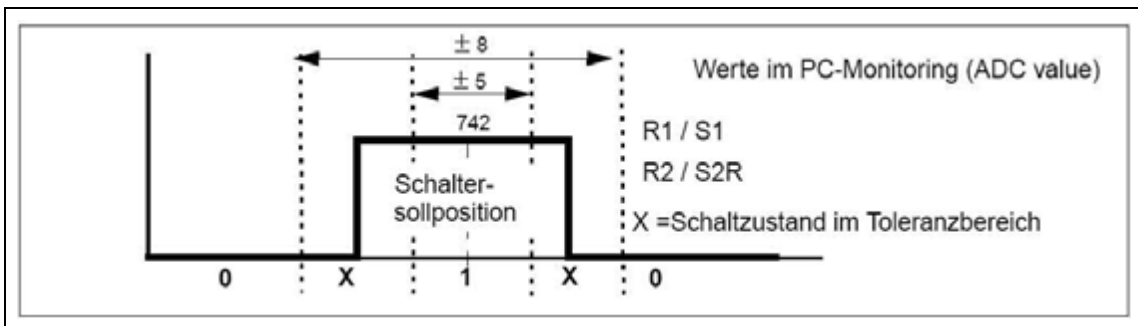


Fig. 21: Switching hysteresis S1_S2

NOTE

It is not possible to adjust potentiometers r1/r2 or reference switches S1/S2. The corresponding lifting column must be replaced if there are defects or malfunctions.

- Move the system into the basic position → 0 ← with the tableside control.
- The position indicator on the control monitor will display the value "1033". Check this with the service PC (MC position) in 1/10 mm (display "10330" / control monitor Z = 1033).

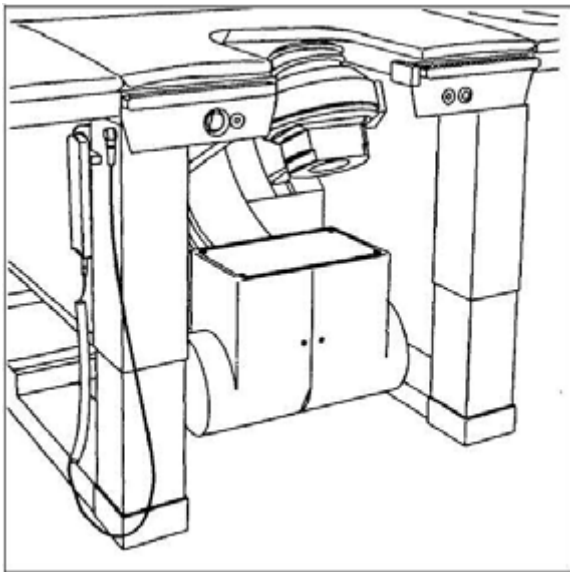


Fig. 22: Lifting column

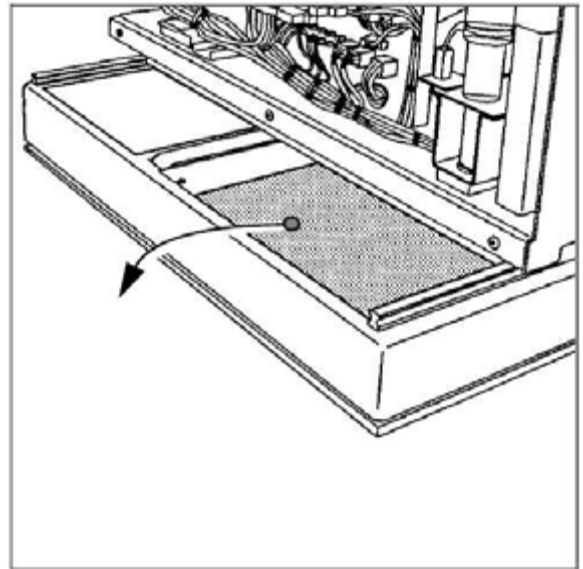


Fig. 23: Removing cover

Preliminary remarks:

To avoid replacing the lifting columns unnecessarily, troubleshoot thoroughly and localize errors accurately.

NOTICE

Removing the lifting column

- ⇒ **When removing the lifting column, use a support (wooden plank) approx. 80 cm to 95 cm high and with a load capacity of approx. 40 kg to support the tabletop. The engineer must obtain this item locally.**

Preparation

- Switch on the system and install the Uro insert.
- Loosen the four cover screws of the front, gray base frame cover and pull the plate out to the side (refer to (Fig. 23 / p. 57)).
- Move the unit into the left or right end position. Disconnect the L/R cables of the lifting columns from the cable harness in the base frame.
- Move the tabletop to the max. height.
- Remove the table extensions.
- Remove all covers of the lifting column affected ((Fig. 22 / p. 57))
- Remove the holding brackets of the covers by removing the screws.
- Unscrew the holder of the energy chain on the left lifting column.
- To remove the tabletop, push the support (wood plank) between the base frame and table.
- Slowly move the table down onto this support until the weight is taken off the column.

NOTICE**Lifting column**

⇒ **Do not retract the lifting column any further after lowering the table onto the support.**

- Switch the system off.
- Remove the 4 M8 Allen screws at the top of the column being replaced.
- Disconnect the plug for the power supply to the motor on the column that is **not** being replaced.
- Switch the system on.
- Select "unregulated motion" with System-Logon-Adjustment-Calibration " as per the "Operating the Service Software" instructions RXL2-120.113.01....
- Select the lifting column drive ZR or ZL.

NOTICE**Danger of collision!**

⇒ **The system is now in "unregulated operation". The movement sequences and the unit movements are no longer monitored. Use caution to prevent collision hazards.**

- Retract the column using the "Table down" button on the tableside control panel.
- Switch the system off.

Removing the lifting column

- Disconnect the plug from the actual value acquisition of the lifting columns (board D31 X10/ X11).
- Disconnect the motor power supply plug.
- Unlock and remove the motor encoder plug.

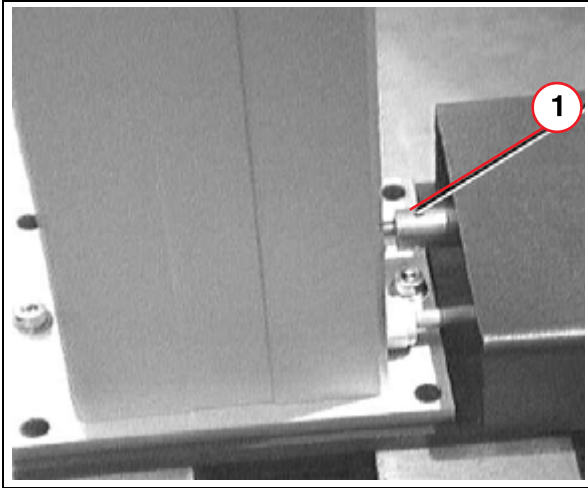


Fig. 24: Allen_screws_A

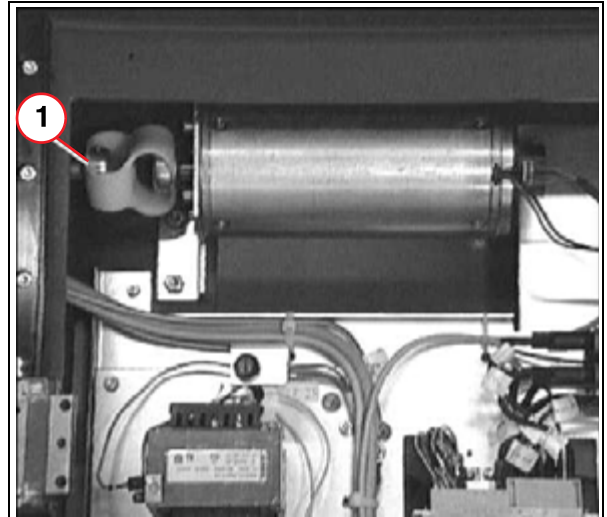


Fig. 25: Allen_screws_B

- Turn the lifting column drive shaft by hand until the Allen screws of the drive shaft are accessible from above ((Fig. 24 / p. 59)).
- Remove the 2.5 mm Allen set screws ((1/ Fig. 24 / p. 59) and (1/ Fig. 25 / p. 59)).
If necessary, remove "Loctite" using a heat gun.
- Remove the mounting screws on the base of the lifting column (Fig. 4) and remove the column.

NOTE

Ensure that the encoder on the motor shaft does not become damaged.

- Remove the drive shaft bearing to replace the cables ((Fig. 26 / p. 60)).
- Remove the strain relief on the two cables for the lifting column.
- Remove the mounting screws on the base of the lifting column ((Fig. 24 / p. 59)) and remove the column.

Installing the new lifting column

- Insert the connection cable of the new lifting column. Ensure that the leads are not twisted.
- Position the column on the base plate.
- Apply Loctite 221 to the screws (Allen M8 x 40). Insert them and tighten them with a torque of $24 \text{ Nm} \pm 10\%$.
- Insert the cable in the bearing guide track of the drive shaft and tighten it gently.
- Secure the strain relief with cable ties.
- Reinstall the drive shaft of the lifting column.

Ensure that the screw engages on the flattened side of the drive shaft.

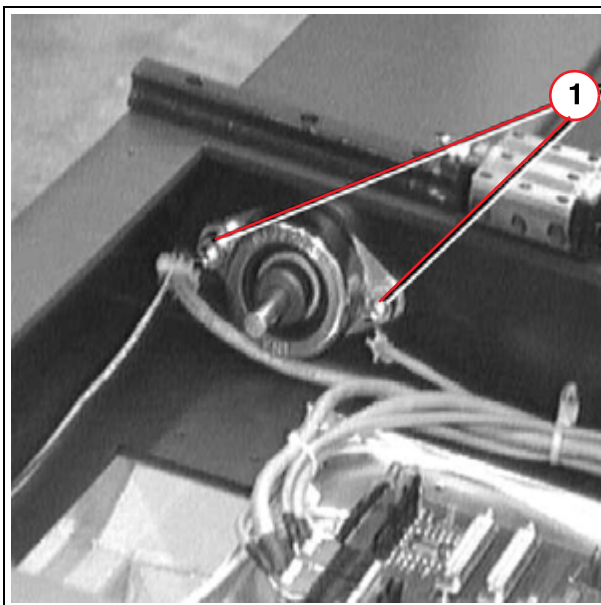


Fig. 26: Drive axle_A bearing

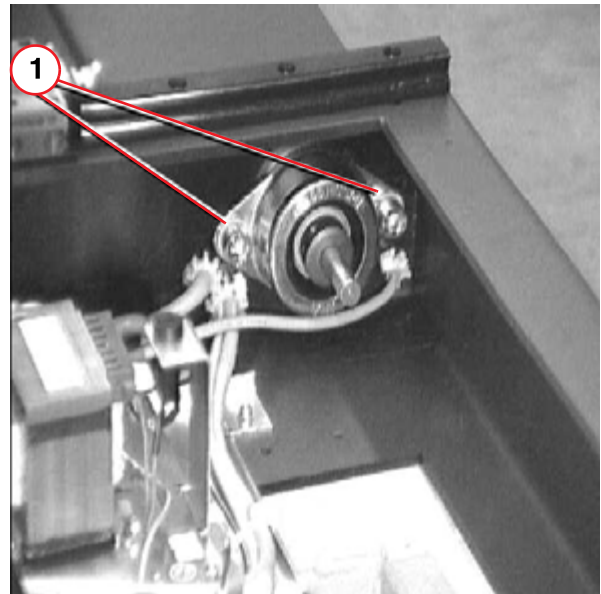


Fig. 27: Drive axle_B bearing

- Reattach the drive shaft bearing with M10x20 screws. Torque: $50 \text{ Nm} \pm 10\%$
- Connect the drive shaft with the PVC coupling (Allen screws 2.5 mm) and bolt the motor down ((Fig. 25 / p. 59)).
- Reconnect the actual value cable to board D31 X 10 or X11.
- Reconnect the power supply and the motor encoder cable.
- Switch the system on.
- Select "unregulated motion" with System-Logon-Adjustment-Calibration " as per the "Operating the Service Software" instructions RXL2-120.113.01....
- Select the lifting column drive ZR or ZL.
- Raise the column in unregulated mode until it just makes contact with the tabletop.
- Apply Loctite 221 to the four Allen screws (M8) and bolt the column to the tabletop from below.

- Switch the system off.
- Install the holding brackets for the covers and the chain holder.
- Reconnect the power supply for the second column.
- Switch the system on.
- Raise the table and remove the tabletop support from the travel range.
- Check the function of the lifting columns.
If necessary, check the "Table tilt" option.
- Reinstall all the covers of the lifting column that was just replaced. Reconnect the protective conductor.
- Reattach the two-part plastic cover at the base of the lifting column. Seal the edges of the plastic cover against the unit or floor with silicon.
- Reconnect the cables to the cable harness in the base frame.
- Close the covers of the unit base frame.

**The following
general issues
apply:**

No special safety measures are required when working on the X/Y drives.

NOTICE

Working on the orbital / W drive

- ⇒ **When working on the orbital drive, secure the C-arm against uncontrolled movement. When working on the W drive, secure the bearing block from backing up into the mechanical stop.**
-

Removing the am4 drive motor

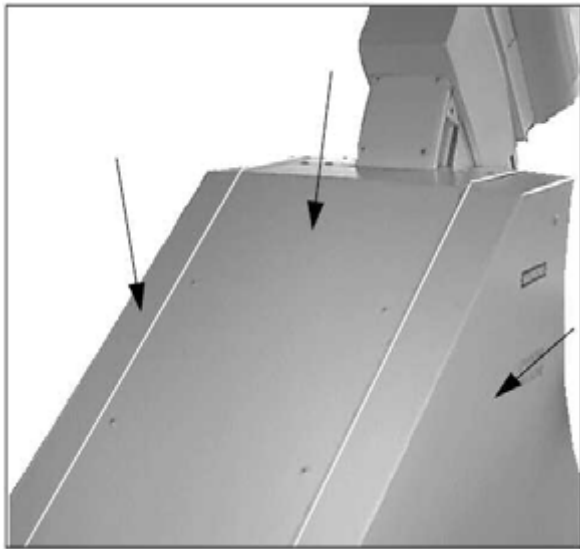


Fig. 28: Covers_A

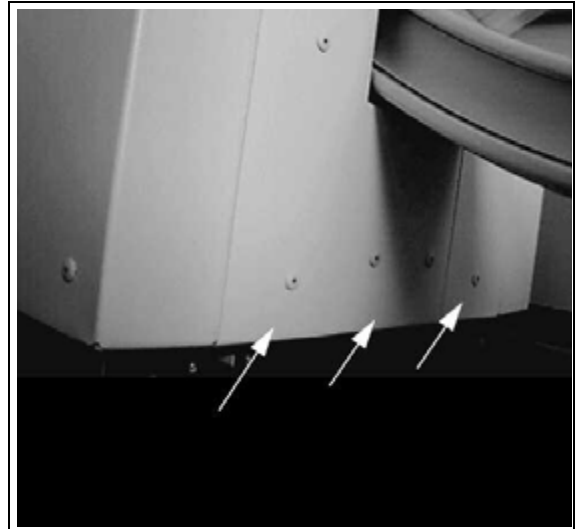


Fig. 29: Covers_B

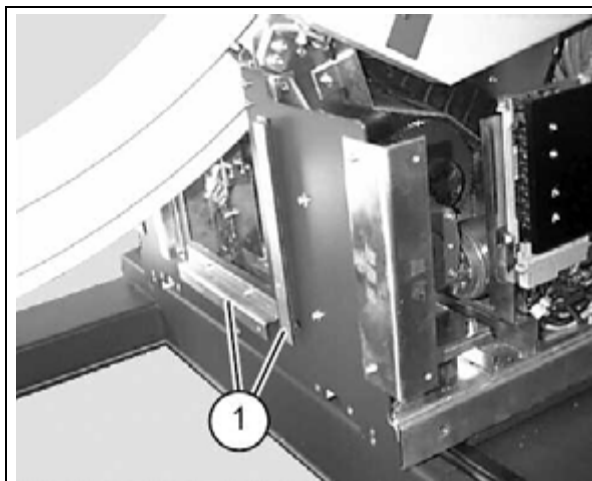


Fig. 30: Retaining rails

Tools required:

- A tensioning belt or similar device approximately 4.5 m long and 25mm wide must be purchased locally.
- 5mm Allen wrench with guide pin

- Move the shock wave head to the therapy position and the C-arm to the 30° position.
- Remove the covers ((Fig. 28 / p. 63)) from the basic system and the X-ray tube.
- Remove the side and lower C-arm covers ((Fig. 29 / p. 63)).
- Remove the retaining rails ((1/ Fig. 30 / p. 63)) for the cover plate.
- Switch the system on.
- Select "unregulated mode" on the service PC.

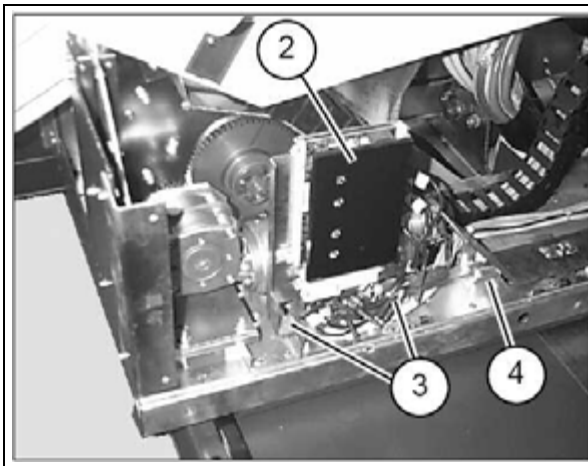


Fig. 31: D7 board

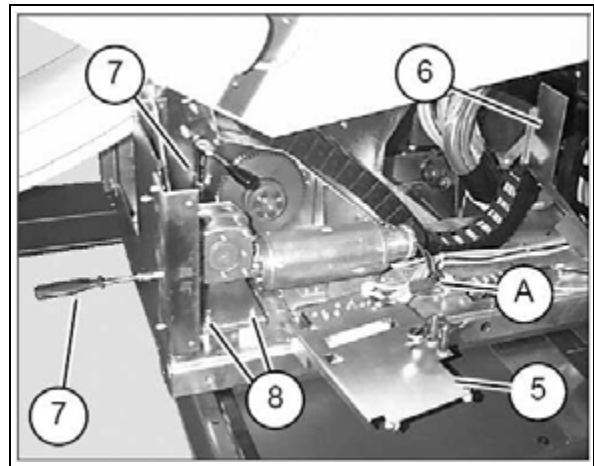


Fig. 32: Board D7_tilted

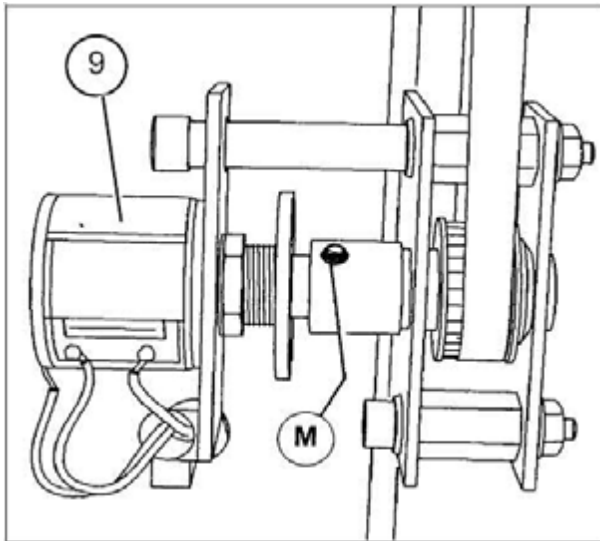


Fig. 33: Potentiometer r4

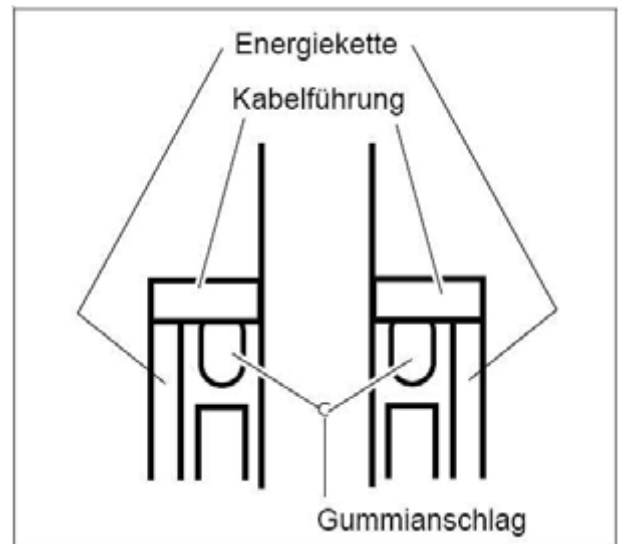


Fig. 34: Rubber end stop

- Move the O drive to the mechanical end stop, passing the 30° position, in unregulated mode so that the rubber end stops are against the mechanical end stop ((Fig. 34 / p. 64)).
- Switch the system off.
- Unplug the motor connector ((A/Fig. 32 / p. 64)).
- Remove board D7 ((2/Fig. 31 / p. 64)).
- Loosen the screws for the D7 board holder ((3/Fig. 31 / p. 64)) and tilt it forward ((5/Fig. 32 / p. 64)).
- Loosen the screw ((4/Fig. 31 / p. 64)) at the energy chain guide.
- Lift up the energy chain guide and secure it above ((6/Fig. 32 / p. 64)).

- Position the tools as indicated in the figure ((7/Fig. 32 / p. 64)) and loosen the screws, but do not remove them.
- Loosen the set screw M (1.5 Allen) at potentiometer r4 ((9/Fig. 33 / p. 64)) on the left side of the system.

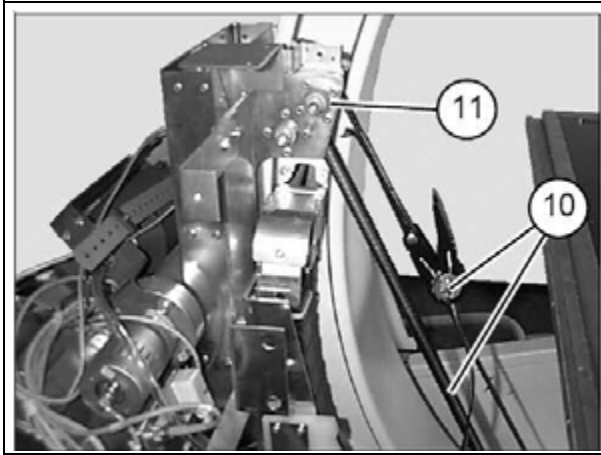


Fig. 35: Tensioning belt_A

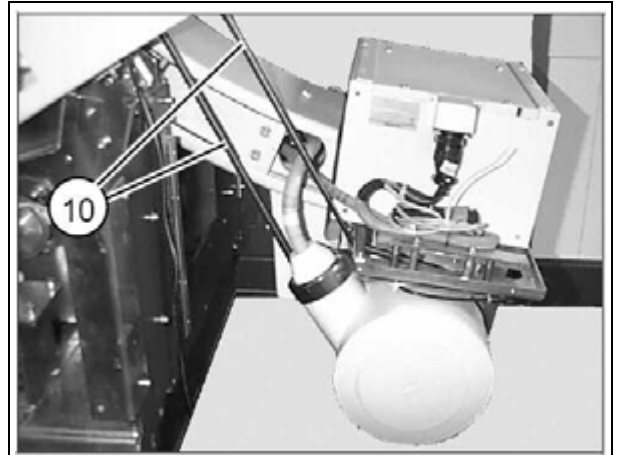


Fig. 36: Tensioning belt_B

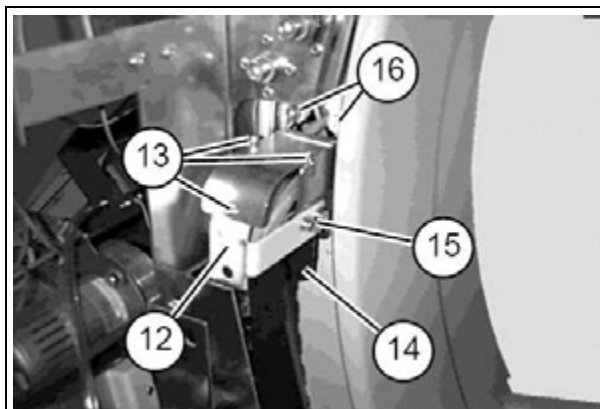


Fig. 37: Cable guides

Replacing the toothed belt

(The am4 drive motor must have been removed).

NOTICE

Risk of accidents!

⇒ **Two persons are always required when working on the C-arm. One person must press against the X-ray tube while the other tightens or loosens the tensioning belt.**

- Remove the I.I. collision protection.
- Attach the tensioning belt ((10/Fig. 35 / p. 65) and (10/Fig. 37 / p. 65)) on one of the sides; route the tensioning belt over the **upper concealed roller** (11/Fig. 35 / p. 65).
- Lift up the C-arm using the tensioning belt until the cable guides ((12/Fig. 37 / p. 65)) are accessible.
- For both the left and right cable guides:
 - Loosen the three screws ((13/Fig. 37 / p. 65)) and remove the cover plate.
 - Remove the rubber end stop ((14/Fig. 37 / p. 65)); the attachment screw (Allen 6 mm) is accessible from above, through the cable harness.
 - Remove the two screws ((15/Fig. 37 / p. 65)).
 - After removing the 4 attachment screws from above ((16/Fig. 37 / p. 65)) and below (in (Fig. 37 / p. 65) concealed), push the holder downward as far as possible.

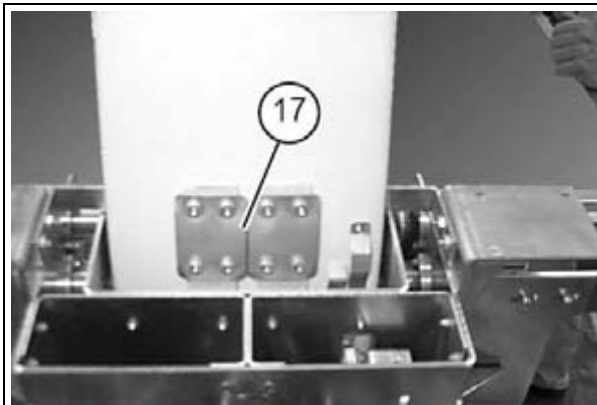


Fig. 38: Attachment plates

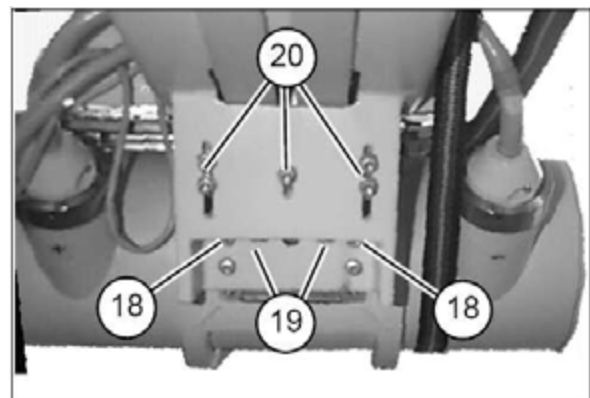


Fig. 39: X-ray tube assembly holder

- Move the C-arm outward as far as possible, passing the -10° position, using the tensioning belt until the attachment plates on the back ((17/Fig. 38 / p. 66)) can be removed.
- Loosen and remove the attachment plates using a 5 mm Allen key **with guide pins**.
- Carefully lower the C-arm to the 30° position; the end stop has been removed.
- Remove both upper screws from the X-ray tube holder ((18/Fig. 39 / p. 66)).
- Remove both tensioning screws ((19/Fig. 39 / p. 66) and (19/Fig. 40 / p. 67)).

- Remove the 5 screws ((20/Fig. 39 / p. 66)).
- Pull the clamp with the belts downward and out. Note the original position to facilitate installing the new belt later.
- Open the clamp and remove both old toothed belts.
- Prepare both new belts by:
 - Cutting them to the length of the old belts.
 - Drilling one side of the toothed belt, Using the old belt as a guide.
 - Inserting them into the clamp; ensuring that the holes of the toothed belt are not inside the clamp.
- Position the clamp for securing the toothed belt with the threaded holes facing downward between the X-ray tube flange and insert the holder on the C-arm ((Fig. 39 / p. 66) and (Fig. 40 / p. 67)).
- Route both toothed belts into the C-arm from below.
- Insert the 5 screws ((20/Fig. 39 / p. 66)) into the clamp and tighten only slightly.
- Insert the tensioning screws ((19/Fig. 39 / p. 66) and (19/Fig. 40 / p. 67)) into the clamp from below and tighten only slightly.

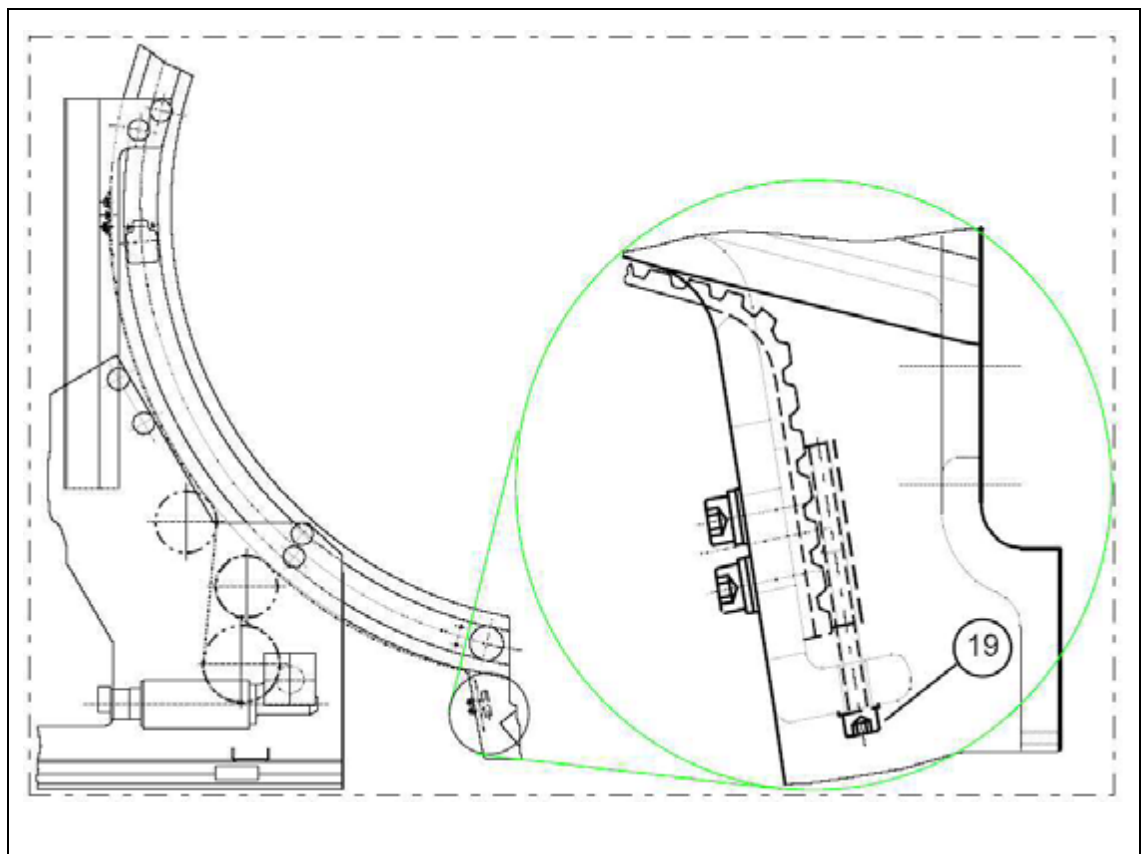


Fig. 40: Toothed belt placement

- Re-tighten both upper screws of the X-ray tube holder ((18/Fig. 39 / p. 66)).
- Raise the C-arm, passing the -10° position, to make the attachment holes visible.

- Route the toothed belt according to (Fig. 40 / p. 67).
- Pull the toothed belt upward and out of the C-arm.
- Insert the screws first through the attachment plate ((17/Fig. 38 / p. 66)), then through the toothed belt and finally tighten them in the C-arm, securing them with Loctite. Use a 5 mm Allen wrench **with guide pin** to tighten them.

NOTICE

Ensure that no steel cables are lying in the path of the screws.



- Lower the C-arm far enough and hold it with the tensioning belt until both cable guides and rubber end stops ((Fig. 37 / p. 65)) can be reassembled in reverse order.
- Lower the C-arm to the 30° end stop and remove the tensioning belt.
- Move the C-arm through its entire range at least four times to align the belt.
- Tighten the toothed belt with both tensioning screws ((19/Fig. 39 / p. 66) and (19/Fig. 40 / p. 67)).
- Tighten the 5 screws ((20/Fig. 39 / p. 66)).
- Move the C-arm through its entire travel range again and check whether the alignment is still correct.

Installing the am4 drive motor

- Install the drive motor by reversing the order in which it was removed, as described in the section "Removing the am4 drive motor".
- Install the holder for board D7.
- Insert board D7.
- Plug in the motor connector.
- Install the holder for the energy chain guide.
- Install the I.I. collision protection.
- Switch the system on.
- Move the C-arm out of the safety circuit in unregulated mode.
- Adjust potentiometer r4 as described in Chapter 4.
- Move the C-arm within the range from -10° to $+30^{\circ}$ and check whether the toothed gears of the drive motor make any noise.
- Re-install all covers.

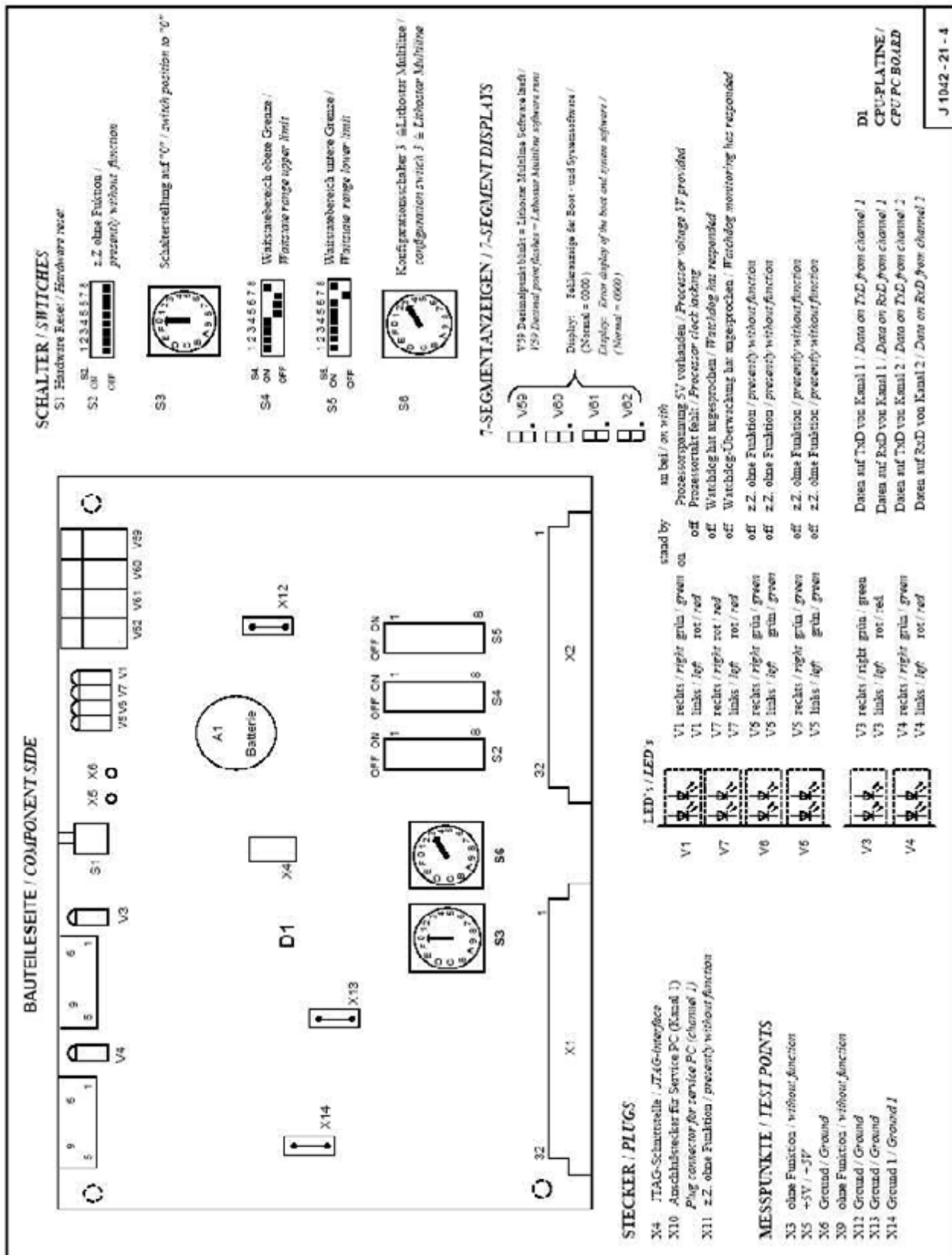


Fig. 41: D1

No changes; initial version.

